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Small Arms Training

Volume I, Pamphlet No. 6

Anti-Aircraft

1942

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(*Continued on page* iii *of cover*)

ADDENDUM

1. At end of section 2 *add* new section as follows :—

2A. Policy for operations and Training

Experience has shown that where all round defence is required it is essential that the weapons should move round the man, (as with the hosepipe method), and not the man round the gun (as with the A.A.L.M.G. mounting). The hosepipe method has the further advantage that the protective trench required to protect the firer can be of much smaller dimensions than that required to accommodate the firer with the A.A.L.M.G. mounting.

Therefore, where sufficient tracer is available for training, the policy will be that the hosepipe method will be used, both during training and operations, by all L.M.G. personnel other than those of anti-aircraft sub-units. Where tracer is not available for training, the method of firing the L.M.G. from the shoulder will be used.

The hosepipe method of firing cannot apply to A.A. sub-units equipped with twin Brens or 20 mm. anti-aircraft guns for two reasons :—

i. The weapons are too heavy and cumbersome for the hosepipe method.

ii. Anti-aircraft sub-units will normally be laid out to cover definite approaches *on a small arc,* for which only limited movement round the gun by the firer is necessary. The limited movement then required will not be a severe handicap to the firer.

Personnel of anti-aircraft sub-units will therefore be trained in the use of the cartwheel sight.

CORRIGENDA

1. Page 3, line 1.—*After* " Platoons " *insert* " and similar sub-units ".
2. Page 3, last line.—*After* " company " *insert* " and similar sub-unit ".
3. Page 4, line 2.—*For* " battalion " *substitute* " unit ".
4. Page 4, sec. 4, line 13.—*After* " platoon " *insert* " or similar sub-unit ".
5. Page 8.—*Delete* last sentence in note.

PART I

ANTI-AIRCRAFT DEFENCE—GENERAL

1. Introductory

1. The principles of protection against aircraft are contained in Field Service Regulations, Volume II, 1935, Section 38, and Infantry Training, 1937, Section 55, as brought up to date from time to time in Army Training Memoranda.

2. So far as troops are concerned, probably the most vulnerable target that presents itself to aircraft is that of a column on the line of march, but all conditions must receive due consideration.

3. Instructions in this pamphlet are concerned only with low flying attacks or dive bombing attacks within 2,000 feet or 600 yards (ground range). These attacks will be made at high speed and will be quickly over, allowing only three to four seconds during which effective fire is possible. These attacks may be repeated at frequent intervals, and may be made either individually by aircraft flying along a column and diving in quick succession, or by a simultaneous converging attack by several aircraft from different directions. The dive bomber peels off at altitudes out of small arms range and dives on its target at an angle of approximately 80 degrees; after release of its bomb(s) it flattens out generally within range of small arms fire, and thence either flies away close to the ground or climbs rapidly out of range.

Against undisciplined or demoralized troops air attacks may have a decisive effect. It is of the utmost importance therefore that all ranks should be trained to withstand the noise of air attack and should be imbued with the necessity of hitting back as hard as possible. In this way very considerable damage will be done to enemy aircraft, making such attacks too costly for him, and in addition it ensures that the morale of our troops is kept up. Troops must not expect that the aircraft when hit will crash immediately. If it remains in the air for only 30 seconds it will fly two or three miles. Personnel therefore must not lose heart if the accuracy of their fire does not bring immediate results.

4. This pamphlet sets forth the main principles of small arms anti-aircraft defence and gives the details of the various lessons to be taught. It is emphasized that the contents and sequence of the lessons are primarily for recruits, and are

based in the first place on the rifle. In units, the small arms anti-aircraft defence will largely be based on the L.M.G. and **the instruction given must be varied accordingly.**

2. Principles of small arms defence

The following are the main principles which must be understood and adhered to :—

i. There must be a system whereby warning of the approach of hostile aircraft is conveyed to troops (*see* Section 4 below).

ii. The maximum fire of all available small arms weapons will immediately be brought to bear on the attacking aircraft, provided that they are within range, unless, for purposes of concealment, specific orders to hold fire have been issued previously.

iii. Subject to ii. above, units of all arms will present to attacking aircraft the least favourable target, according to the situation in which they find themselves. Whenever there is time slit trenches or weapon pits should ALWAYS be dug and alternative positions added if the position is to be occupied for any period. The utmost care should be taken in the camouflage of these weapon pits.

iv. If movement in M.T. is unavoidably stopped, it must be continued at the earliest moment.

v. When troops are on foot, the fire of all available L.M.Gs. and rifles will be used.

vi. In bivouacs, billets, or when otherwise halted, L.M.Gs., suitably sited and concealed, should form the main small arms defence. Concealment from view is of the utmost importance, and a 360 degree arc of fire may have to be sacrificed in favour of concealment.

vii. To be effective, fire must be controlled.

viii. Speed in opening fire is essential. This requires strict fire discipline training as well as early recognition.

3. Protection

Every commander is responsible for the protection of his command against surprise, and for concealing his dispositions from enemy troops and aircraft.

i. *On the move.*—With troops on the march, or in M.T., the time and ground factors will preclude, as a normal procedure, the possibility of advance across country, and, except in small columns, of large spaces between units and sub-units.

Platoons will normally move with sections staggered on either side of the road. Irrespective of light anti-aircraft protection, columns must be protected by L.M.Gs. mounted on Motley and other mountings moving within the column itself.

On the march, units must protect themselves with all their available small arms weapons.

Since there will not be time to issue orders for opening of fire through the usual chain of command, responsibility must be delegated. Dispersion to the sides of the road or to whatever cover may be immediately available must be immediate down to the fire unit (the section), or to groups of a few men in the case of heavy air attack. No matter to what extent dispersion has taken place *fire must always be controlled*, and under no circumstances must it be allowed to become indiscriminate.

Men will march with magazines charged with ten rounds, L.M.Gs. will have magazines on ; sights will be set at 500 yards.

ii. *When halted.*—The fire of the L.M.Gs. is the most economical form of protection. Unless there are obvious lines of approach for attacking aircraft, it should be organized in the form of area defence, the guns being sited not less than 500 yards or more than 800 yards apart at the corners of a series of triangles, so disposed as to cover the area to be protected. It is obviously an advantage to site guns in such a way as to produce a greater volume of fire in the more likely lines of approach of enemy aircraft. One or more alternative weapon pits should be constructed at the earliest opportunity, and the gun position moved frequently during any lulls in the attack. Dummy weapon pits, visible to the enemy, but not blatantly so, should be built to draw his fire.

All guns must have protection and concealment so far as time and facilities allow ; the confidence of the firer is thereby enormously increased.

Protection can be afforded by digging slit trenches and weapon pits as small as is practicable, or by making use of natural features ; concealment is best gained by making the utmost use of natural features, such as bushes, or of shade.

The vital importance of withholding the opening of fire until the aircraft is well within range must be stressed upon all ranks.

When troops are concealed, definite orders must be issued if the L.M.Gs. are NOT to open fire against hostile aircraft ; the opening of fire may betray to the hostile observer the fact that the area is occupied.

During short halts, A.A. L.M.Gs. will be dispersed under company arrangements. During long halts, or in camp,

billets, or bivouacs, the anti-aircraft defence will be co-ordinated under brigade and battalion arrangements in order to ensure that the maximum fire can be opened along the more likely lines of approach of attacking enemy aircraft.

4. Warning and air sentries

The efficiency of the defence will depend firstly on the speed at which warning of the attack can be conveyed to subordinate commanders ; secondly, on the quickness with which warning can be followed by executive orders for movement or fire, and lastly on the skill, steadiness, and fire discipline of the troops.

In nearly all attacks there will not be more than a few seconds' warning, even with quick, well trained air sentries. These few seconds will be valuable with well trained and disciplined troops.

The number of air sentries to be detailed must depend on circumstances, but should not be less than one per platoon on the march, and one for each gun at the halt. The direction and area in which each sentry is to watch must be carefully co-ordinated.

The work is exhausting and entails considerable strain on the eyes. Constant reliefs will, therefore, be essential.

Sentries must be taught to listen for the sound of approaching aircraft and to watch the likely lines of approach which hostile aircraft may use in order to obtain surprise, e.g. out of the sun, from over low hills, woods, or from out of clouds.

Sentries must have experience in the recognition of aircraft, but if in doubt as to whether an approaching aircraft is hostile, it is better to give the warning in order that all ranks may be ready to engage as soon as identification is assured.

Details of warning signals are given in Lesson 10.

5. Ranging

Small arms fire may be taken as effective up to 2,000 feet. While it may be taken as a rough guide that at this range an aeroplane is almost a silhouette and that within this range details will become apparent, practical experience is the only sure guide. Until this experience is gained the Murray range-finder (1 per section, or A.A. L.M.G.) gives a guide as to whether the aircraft is in range.

With a little experience it is comparatively easy to decide whether an aircraft is within range or not ; nevertheless it is a common error to open fire at targets which are out of range. This is merely waste of ammunition and must be guarded against.

Training should be carried out with the co-operation of aircraft when available, by demonstration flights arranged

at a height of 2,000 feet, and at distances over and within that range. Full use will be made of opportunities of ranging on aeroplanes during training.

6. Recognition

It is a principle that every hostile aircraft must be engaged with small arms fire if it is within range and if it is recognized as hostile, unless concealment is of primary consideration.

The whole problem is the instant identification of friend from foe in such time that fire may be opened while the aircraft offers the most favourable target. The committing of a hostile act, such as dropping a bomb, gives certain identification but may be too late for the aircraft to be engaged while it presents a good target. Hostile markings are also a sure guide, but they are visible only when an aeroplane is crossing or overhead : this may be too late for successful engagement.

It is essential, therefore, for all ranks to receive thorough training in recognition by silhouette, and every opportunity and encouragement must be given for constant practice on aircraft. Unless certain that an aircraft is friendly, L.M.Gs., etc., should be trained on it ready to open fire instantly should it be recognized as hostile. The whole question of recognition is treated separately in Part II of this pamphlet.

7. Considerations in training

1. Sub-units whose primary role is A.A. defence, such as the A.A. platoon of infantry battalions, are being equipped with a special sight for engaging aircraft, and the training of personnel in its use is dealt with in a separate pamphlet (to be issued shortly).

Part I of this pamphlet is concerned with the training of riflemen and light machine gunners in the normal sections—in the case of the light machine gunners, both with and without the use of tracer ammunition. Riflemen and light machine gunners will receive basic training on identical lines.

It is not practicable to provide the ordinary man in the ranks with any form of anti-aircraft sight or other mechanical aid for either the rifle or the L.M.G. Extreme accuracy of fire must, therefore, give way to quick retaliation and volume. Estimation of range can be limited to a knowledge of when fire can be usefully opened. Training will, therefore, primarily be concentrated on obtaining :—

i. Speed in opening fire. The time available will depend on early warning and quick recognition of friend from foe. Measures must be taken to ensure that all weapons are able to open fire in a few seconds.

ii. Strict fire discipline, to ensure that fire is opened only when the target is in its easiest position.

iii. The maximum volume of controlled fire, whether using tracer or not.

2. Practice firing with tracer may be carried out on anti-aircraft ranges, out to sea or on suitable areas of moorland where a 90 degree arc, with a radius of 3,500 yards, is available as a danger area.

Two types of practice targets are suitable :—

i. Sleeve targets towed by aircraft (rarely available).

ii. Balloons filled with hydrogen.

Every endeavour should be made to exercise in hosepipe firing those personnel who will use this method. Other personnel can be exercised on similar lines without tracer as per Lesson 7.

8. Type and choice of target

1. Aircraft attacking will present three main types of anti-aircraft target.

i. The direct attacker, or zero approach angle.

ii. The direct crosser, or very wide approach angle.

iii. The attacker in between these two extremes, or narrow approach angle.

2. It will not always be possible to open fire on enemy aeroplanes at the moment they present the easiest target. But for the reasons given below, attacking aircraft should be engaged at the narrowest possible angle of approach :—

i. The head-on shot is the easiest target.

ii. An aeroplane is more vulnerable in front.

iii. When tracer is used, the pilot may see the tracer coming up towards him. Even if this does not turn him away from his target, it will certainly distract him, possibly putting him off his course and causing him to miss his target.

iv. Penetration is increased if the plane is flying into rather than away from the bullet.

3. The wide angle of approach shot or direct crossing plane is not so satisfactory, because :—

i. The wider the angle of deflection the greater the margin for error. If tracer is available, and being

used, the greater will be the difficulty of observing fire correctly.

ii. The largest part of the target with a crossing shot will consist of the fuselage which is the least vulnerable part of the aircraft.

4. The "going-away" shot is the least satisfactory because :—

i. All operational planes are now armoured against attack from the rear.

ii. The penetrative power of a bullet fired at a receding plane is considerably reduced owing to the speed at which the plane is flying.

From the above it is apparent that the majority of targets which should be engaged will be head-on or narrow angle of approach, and that in consequence training should largely be at these targets.

9. The lead

Since no mechanical aid is practicable it will be necessary to assist the firers to aim sufficiently far in front of an aircraft (other than direct attackers) by means of a lead. In theory, the amount of lead required is infinitely variable, depending on the speed and angle of approach of the aircraft. In practice, however, as the lead is only a guide to ensure that men get well ahead of their target (the common fault is always to be behind), the leads used can be reduced to two for simplicity. Volume of fire, therefore, must replace extreme accuracy. All ranks must receive instruction as to how they can recognize these leads in the sky. The swing of the weapon is of the utmost importance, and it must be impressed on all troops that the movement of the rifle or L.M.G. must not be checked at the moment of pressing the trigger. The different types of target and lead therefore required are :—

i. Direct attacker	No lead.
ii. Direct crosser, i.e. when more than half of the fuselage is visible ...	12° lead.
iii. Narrow angle of approach, i.e. when the fuselage is foreshortened to half its length or less	6° Half lead.

10. Hosepipe firing

When tracer is available firing from L.M.Gs. will be by the "hosepipe method." The gun is not fired from the shoulder, but from against the hip, in the standing position, and from between the thigh and the groin in the kneeling position.

The gun does not kick but tends to push the firer backwards. This tendency must be counteracted by adopting the correct positions.

Fire is directed on to the target by the observation of tracer.

Accurate shooting depends on three factors : correct lead and swing, and rapid corrections, if necessary, from observation of fire.

The gun must be swung smoothly along the line of flight of the aircraft before the trigger is pressed, and the trigger must not be released until the aircraft is out of range, the magazine is empty, or the order to "stop" is given.

The lead required depends on the speed of the aircraft and the angle of approach. It must be remembered that the natural tendency is to miss behind the target.

The application of fire is controlled by the observation of tracer : unless the aeroplane is approaching at the narrowest possible angle of approach, i.e. the head-on shot, the stream of bullets will be travelling at an angle to the course of the target and will appear to have a distinct lateral curve. The wider the angle of approach the more pronounced is the apparent curve. The curve is purely an optical illusion and must be ignored. *To ignore the curve the eye must be closely focused on the target and must not follow the flight of the tracer.* The tracer will then only be seen as it flashes by or into the target, and will be appreciated correctly. When firing against hostile aircraft a hit will be unmistakeable, as the tracer will either disappear or jump off at a tangent. In observing fire it must be remembered that there is an appreciable time between the firing of the gun and the arrival of the bullet at the target. This fact must be remembered when correcting elevation or rate of swing. The first essential is to gain correct elevation ; until this is done it is difficult to get correct deflection. When loading magazines with tracer ammunition the normal proportion is one round of tracer to three rounds of Mark VII, i.e. one in four. Effective results can be obtained with a proportion of up to one in seven.

The first round out of the gun must be tracer ; the last seven rounds to come out, i.e. the first seven to be filled into the magazine, should be all Mark VII. The magazine will be empty before application by observation of fire of these last rounds can be made.

NOTE.—Although hosepipe depends on the observation of tracer for its effect, yet it is possible, with particularly well-trained troops who have an instinctive feel of their guns, when firing at narrow angle of approach targets, to fire effectively from "hosepipe positions" without tracer. This method of engaging targets will be abnormal.

11. Training apparatus

Officers responsible for training should study carefully Appendix I, page 26, which gives in detail the methods of preparing and setting up all of the apparatus required for teaching lessons in anti-aircraft training. Should the apparatus not be available, improvisation should be the aim.

The spotlight projector should be looked upon as one of the most valuable means of teaching the soldier to aim and fire quickly at aircraft, and use of it should be made throughout the soldier's service. The projector is intended to provide an instructor with a means of checking correctness of aim, judgment of deflection and swing. The light takes the place of the bullet, thus adding interest and allowing the individual to see the results of his fire. In particular with the L.M.G., the light must be regarded as taking the place of the tracer ammunition, and so providing valuable training in firing by the hosepipe method.

When units are not exercised in anti-aircraft training with the rifle and are being taught the L.M.G. only, the relevant portions of Lessons 1, 2, and 4 must be given before commencing Lessons 7, 8, 9, and 10.

LESSON 1.—ANTI-AIRCRAFT DEFENCE

This lesson will be given in the form of two or three lectures and demonstrations, whenever possible illustrated by diagrams. The basis of these lectures and demonstrations will be a summary of Sections 1 to 10: the hosepipe method being fully explained.

Precis of lectures :—

1. Introductory.
2. Principles of small arms defence.
3. Protection and defence against air attack on the move and when halted.
4. Warning and air sentries.
5. Ranging.
6. Recognition.
7. Considerations in training.
8. Type and choice of targets.
9. The leads.
10. Hosepipe firing.

LESSON 2—DIRECT ATTACKER (RIFLE)

Instructor's Notes

Stores.—

Diagrams of diving and climbing aeroplanes fixed along the top of all four walls of the barrack room or place of parade, in such a way as to allow of the 25 degrees safety angle.

Squad in two ranks, 10 yards or less from the diagrams. Order: "Standing"—"Charge magazines"—"500"—"Rest."

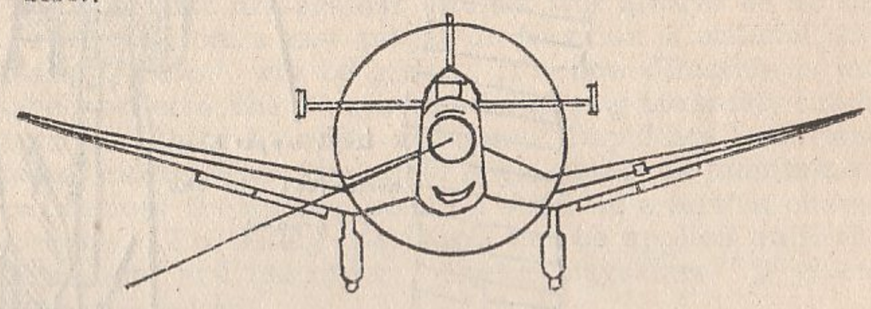


FIGURE 1.

1. i. Explain that, owing to the high speed of modern aircraft, it is essential that fire should be delivered quickly and with reasonable accuracy. This lesson deals with the method of firing at diving and climbing aeroplanes. There are two rules of aiming (*see* Figure 1) :—

   (*a*) Sights set at "500."

   (*b*) Align the sights on the centre of the aeroplane.

   ii. Demonstrate from the standing position :—
   Aircraft action.
   Aircraft front.
   Firing.
   Stop.
   Charge magazines.

2. Explain and demonstrate with squad imitating :—

   i. **Aircraft action.**—On the order "Aircraft action" adopt the standing load position with the muzzle of the rifle as vertical as possible and load, leaving the safety catch forward.

   ii. Practise squad.

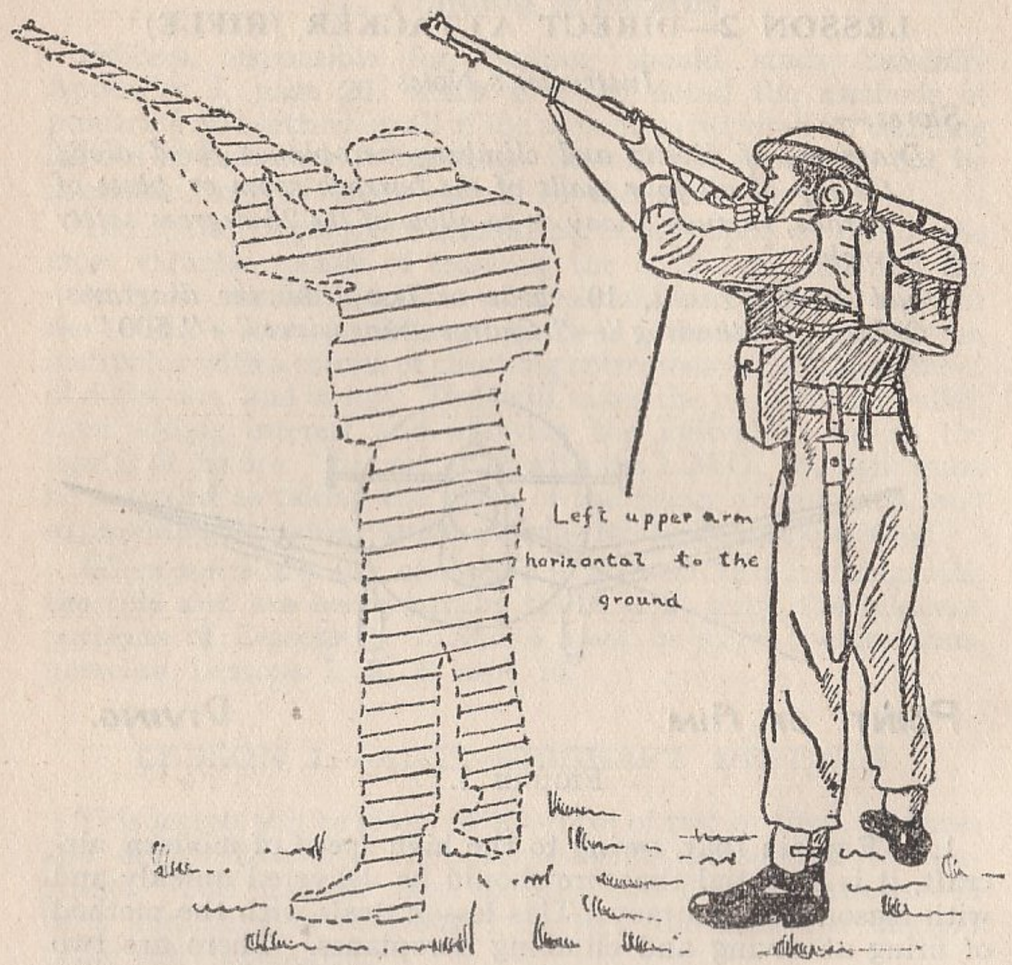


FIGURE 2.

iii. **Safety.**—Care must be taken when engaging low flying aircraft that the rifle is not fired so low as to endanger our own troops. A useful guide is that the upper part of the left arm must be parallel with the ground (*see* Figure 2).

iv. Practise squad.

3. **Quick aiming and turning.**—

i. Explain that, owing to aircraft being within range for such a short period, it is essential that all movements, such as coming into the aiming position and changing direction,

should be carried out with the utmost speed. A standard of firing the first shot within two seconds should be the aim.

ii. Explain and demonstrate with detail :—

On the order " Aircraft front," raise the rifle quickly to the aiming position, take first pressure and aim. On a new direction being ordered, turn quickly, pivoting on the right leg, in the direction named and aim. Finally, return to the loading position.

iii. Practise squad.

4. **Firing.**

i. Explain that fire against aircraft will always be at the rapid rate. Before a new target or direction is ordered, the command " Stop " will be given. If a new direction is immediately ordered, the man, without applying the safety catch, will turn quickly and, on the command " Rapid fire ", continue to fire as before. When the safety angle cannot be maintained, men will adopt the loading position and load a further charge if necessary. The safety catch will not be applied until the attack is over and the order " Charge magazines " is given.

ii. Practise squad.

LESSON 3.—DIRECT ATTACKER (RIFLE—SPOTLIGHT)

Instructor's Notes

Stores.—

Diagrams of diving and climbing aeroplanes as in Lesson 2.

One rifle fitted with a spotlight projector apparatus with flex and transformer. (See *page* 33.)

Aiming rest placed in the centre of the room, in order that diagrams are on all sides and approximately at equal distances from the aiming rest.

Forms or chairs as required.

As proficiency increases, this lesson can be repeated with respirators.

1. Practise each man in firing—by word of command (men should stand close to the aiming rest) :—

" Without dummies " ; " Standing "—" Charge magazines "—" 500 "—" Rest "—" Aircraft action "—" Aircraft front "—" Rapid fire "—" Stop "—" Aircraft about" —" Rapid fire "—" Stop "—" Rest."

On the order " Rest," men will lower the rifle gently to the ground in order not to disturb the focus and registration of the projector.

Repeat the above as necessary, using targets in all directions, i.e. right, left, front, and about, until the men develop quickness in firing and turning. Each man should be given not more than two directions before the order " Rest."

2. Repeat, using dummies.

LESSON 4.—THE LEAD (RIFLE)

Instructor's Notes

Stores.—

Model aeroplane with pole and stand fitted with movable arm, rectangle, and line-of-flight rod (see *Figure* 12). *Set up with a sky background.*

12 *degrees displayed in barracks at* 10 *yards,* 30 *yards and* 100 *yards.*

The model aeroplane will be set up as a direct crossing plane with the rectangle a 12 *degrees lead in front. Distance from the centre of the stand to the centre of the aiming rest —nine yards.*

Place rifles on the aiming rests.

It may be convenient, on occasions, to combine Lessons 4 *and* 5 *into one lesson.*

1. Explain that it was necessary to aim off a " lead " in front of moving targets on the ground (Rifle—Lesson 12), and that the same principle will apply in aiming and firing at aircraft crossing the front. A lead will therefore always be maintained in front of all crossing targets, with the narrow angle approach six degrees or the half lead, and with the wide angle of approach 12 degrees or the lead. The two rules of aiming at crossing aeroplanes are :—

i. Sights set at 500 yards.

ii. Direct the rifle the required lead in front of the aeroplane and in the direction of its flight. Maintain the lead by swinging with the aeroplane, and fire without checking the swing.

2. i. Question squad on the method of measuring degrees taught in application of fire (Lesson 6), and explain that each man must measure for himself what part of his left hand when at arm's length will give 12 degrees from the nose of the aeroplane to the centre of the rectangle (*see* Figure 3). The parts

of the hand which give this measurement at 10 yards will also give 12 degrees at any range.

ii. Practise squad at 10 yards measuring the lead in the aircraft action position with the left arm extended.

3. Lower the rectangle. Practise squad aiming off six degrees and 12 degrees, with and without the aid of the hand. Check by the rectangle.

4. i. Explain that all ranks should practise the leads against a sky background and on clouds until the measurement becomes instinctive.

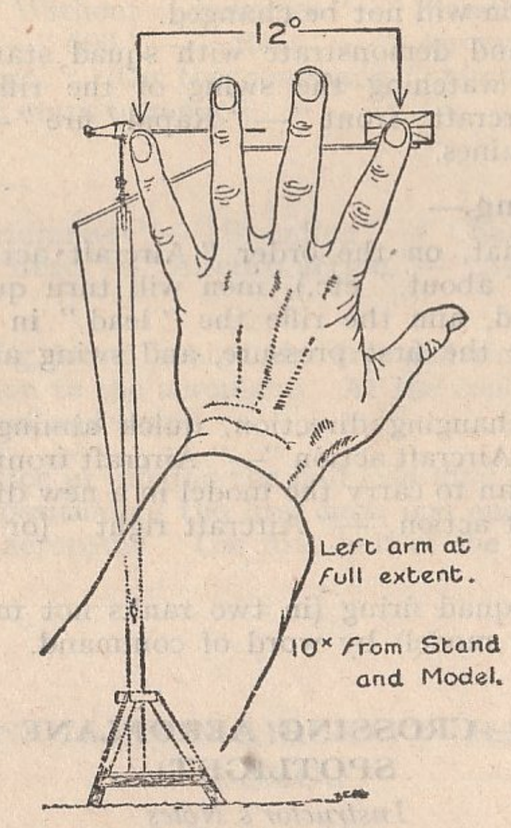


FIGURE 3.

ii. Practise squad in estimating the lead and half lead at distances of 30 yards and 100 yards which have been previously measured and marked out, and provide a sky background. (*See* Appendix I, Figures, 9, 10, 11.)

5. Practise squad at ranges up to 600 yards in estimating the lead and half lead.

LESSON 5.—CROSSING AEROPLANE (RIFLE)

Instructor's Notes

Stores.—

Model aeroplane with pole.—The model to be carried by a fatigueman at a brisk pace on the front and flanks of the squad at not more than six yards' distance.

Squad in two ranks.

Order : "Standing"—"Charge magazines," "500," "Rest."

1. i. Explain that the lesson teaches the use of the "lead" at crossing aeroplanes. Question squad on the two rules of aiming, and emphasize the continuance of the swing at the moment of firing. The feet may be moved to suit the swing, but the direction will not be changed.

ii. Explain and demonstrate with squad standing behind the instructor watching the swing of the rifle—"Aircraft action"—"Aircraft front"—"Rapid fire"—"Stop"—"Charge magazines."

2. **Quickening.—**

i. Explain that, on the order "Aircraft action"—"Aircraft right" ("about," etc.), men will turn quickly in the direction named, aim the rifle the "lead" in front of the aeroplane, take the first pressure, and swing along the line of flight.

ii. Practise changing direction, quick aiming and swing. Commands : "Aircraft action"—"Aircraft front"—"Rest." Order fatigueman to carry the model in a new direction, then order "Aircraft action"—"Aircraft right" (or according to new direction).

3. Practise squad firing (in two ranks not more than six yards from the model) by word of command.

LESSON 6.—CROSSING AEROPLANE (RIFLE—SPOTLIGHT)

Instructor's Notes

Stores.—

A rifle fitted with a spotlight projector. Model aeroplane. Aiming rest ten yards from the centre of the run of the moving aeroplane. (See *pages* 37, 38, *and* 39.)

An assistant to work the model aeroplane.

1. i. Explain that the lesson gives further practice in instinctively judging the "lead," aiming and firing at crossing aeroplanes.

ii. Practise each man in judging the "lead" from a stationary aeroplane by ordering the man to aim at a point which he estimates to be 12 degrees in front of the aeroplane and say "On" (*see* Note below). Then press the switch and check by means of the position of the spot of light in relation to the nose of the aeroplane. Disturb the rifle after each aim.

2. **Aiming and swing.—**

Remove rifle from the aiming rest. Each man will be ordered to judge his lead, aim, and swing in the direction of flight. Press switch at intervals. At the conclusion of the run discuss the "lead" and "swing."

Order : "Without dummies"—"Standing"—"Charge magazines"—"500"—"Rest"—"Aircraft action"—"Aircraft front." (On the command "Aircraft front," the aeroplane will start to move.)

3. **Firing.—**

"Without dummies"—"Standing"—"Charge magazines"—"500"—"Rest"—"Aircraft action"—"Aircraft front"—"Rapid fire."

During firing, stand behind the firer and watch the spot of light in relation to the aeroplane. At the conclusion of firing discuss the lead and swing.

NOTE.—Practice in judging the half lead may be given by the instructor positioning the firer near one end of the run of the model aeroplane. The first half of the run only being used.

LESSON 7.—ANTI-AIRCRAFT HANDLING (L.M.G.)

Instructor's Notes

Stores.—

Gun, magazines and dummies, magazine box, model aeroplane on pole set up as direct attacker. A fatigueman to carry the model as required.

1. Explain : i. The gun will always be ready for action against aircraft in a position which affords a field of fire over as wide an expanse of sky as possible, at the same time allowing

it to be protected and concealed. It is often impossible to obtain an all-round view of the sky and maintain concealment. The siting of the guns in an area (*see* Section 3, ii., page 3) must, therefore, be co-ordinated under unit arrangements in order that each can watch a portion of the sky. When cover is inadequate, camouflage should be used.

ii. The team required to operate the gun in action against aircraft will consist of four, though three is often sufficient. Their duties will be as follows :—

Section commander.—Select the position for the gun in accordance with the plan. Direct and control the fire.



FIGURE 4.—Hosepipe—kneeling from the thigh.

In normal circumstances, control will be by word of command and signals (*see* Lesson 10).

No. 1.—Fire and maintain the gun in action; and, if operating alone, as when the gun is mounted on a vehicle, select a suitable target and control his own fire.

No. 2.—Assist **No. 1** to change magazines.

No. 3.—Keep magazines filled and supplied to the gun. The other members of the section may be used for protective duties and replenishment of ammunition.

iii. The magazines of those guns allotted to a unit primarily for anti-aircraft defence (i.e. the A.A. platoon of H.Q. company) will be filled in the proportion of one tracer to three Mark VII, but when tracer is short one in seven may be used with effect. The last seven rounds to come *out* of the magazine, should be all Mark VII.

iv. There are two main "hosepipe" positions from which the gun can be fired, and two alternative positions when hosepipe is impracticable if no Motley or similar mounting is available.

Hosepipe.

(*a*) Kneeling from the thigh. This is the most suitable position (*see* Figure 4).

(*b*) Standing from the waist (*see* Figure 5).

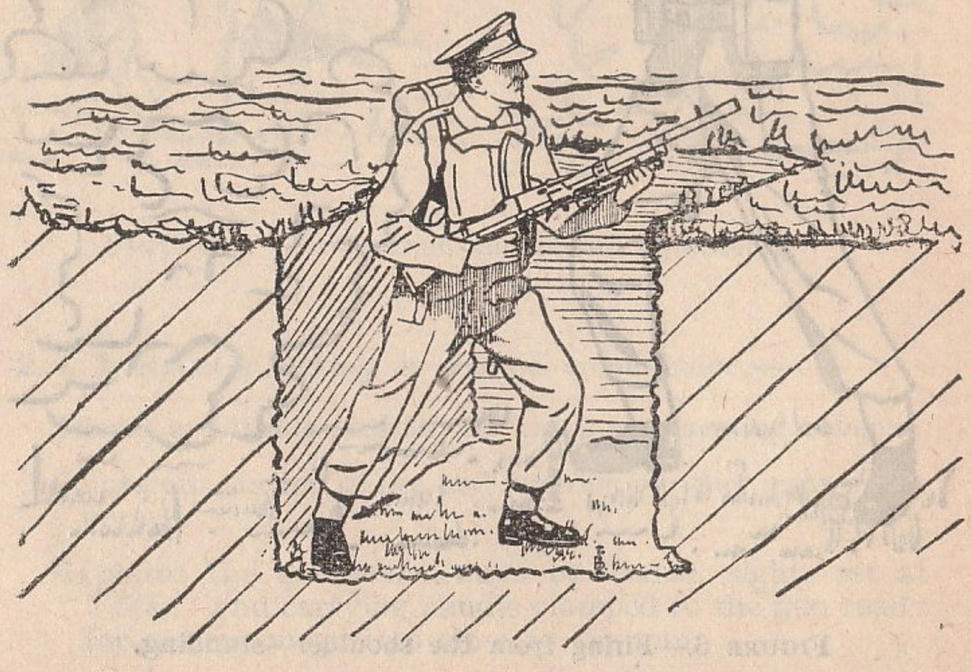


FIGURE 5.—Hosepipe—Standing from the waist.

Not hosepipe.

(*c*) Standing or kneeling (firing from the shoulder when no tracer is available and provided the soldier is of good physique). These are suitable when firing ·303-inch Mark VII, as the initial lead and elevation can be obtained by the use of the sights. Company guns can quickly engage ground targets from these positions, and *vice versa* (*see* Figures 6 and 7).

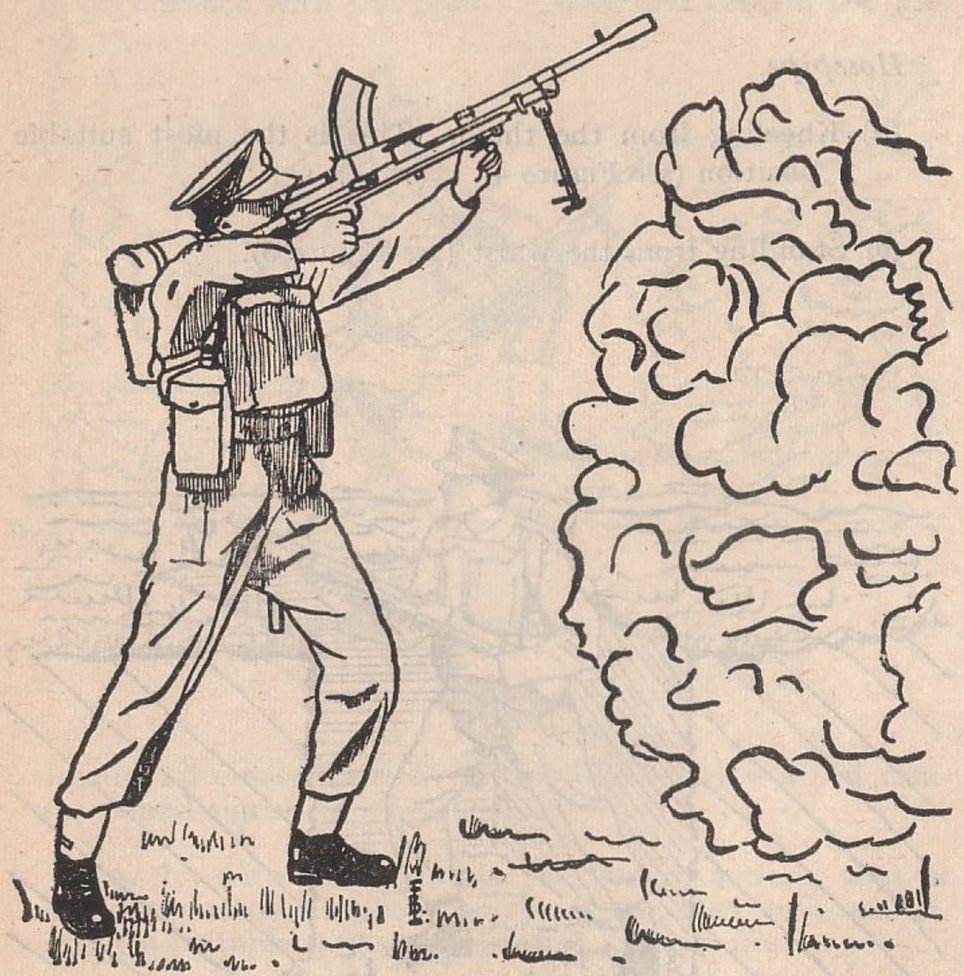


FIGURE 6.—Firing from the shoulder—standing.

v. Explain briefly hosepipe fire. When firing tracer the sights are not used, but fire is directed by watching the tracer at or near the target and applied accordingly. It is important to focus the target and not to watch the whole stream of tracer through the air.

vi. Care must be taken when engaging low-flying aircraft that the gun is not fired so low as to endanger our own troops.



FIGURE 7.—Firing from the shoulder—kneeling.

2. i. Instructor, acting as section commander :—

Selects a suitable position for the gun (stressing cover).

Points out the arc of fire and position of other guns in the area.

Explains the gun will always be loaded, sights set at "500," and carrying handle clamped to the gun ready for action, magazines close to the gun.

Orders Nos. 1 and 2 to get the gun ready for action.

3. Explain and demonstrate (using one of squad as No. 2) :—

i. **Aircraft action.**—No. 1 will put the change lever to automatic and adopt either (*a*) kneeling position, with the butt resting on the thigh, right knee turned well out, the left hand holding the carrying handle, and with folded bipod legs or the left bipod leg hanging down, whichever suits the particular firer best (*see* Figure 4) or (*b*) standing position, from the waist, the gun being held close to the side, with the butt in whichever position is most convenient to the individual firer, i.e., resting in front of the right hip, behind the right hip or under the arm pit, left hand as for kneeling position. The body must be firmly balanced with the left foot well in advance of the right, weight of the body well forward on the left foot (*see* Figure 5). No. 2 will take up a position close behind No. 1 in either position, ready to change magazines when ordered. Cover is as essential for No. 2 as for No. 1.

ii. **Aircraft front, etc.**—Turn quickly in the required direction. If the shoulder position is to be used, raise the butt and hold it firmly in the shoulder with the left hand, pushing the right shoulder forward into the butt. The position of the body is as when firing from the waist (*see* Figures 6 and 7).

(Rules of aiming when engaging aircraft from this position, i.e., without tracer, must be applied as for the rifle.)

iii. **Rapid fire.**—Press the trigger and keep it pressed until the magazine is empty or "Stop" is ordered. It is important to fire in a long continuous burst. Apply the hosepipe method if using tracer.

iv. **Assistance by No. 2 in changing magazines.**—No. 1 cocks gun, removes magazine while No. 2 places a full magazine on the gun.

v. **Stop.**—If this order is not followed by a new direction immediately, place the gun on the ground and change magazine, if necessary. Put change lever to "safe."

4. Practise squad in all positions at direct attacking, and at crossing planes by word of command and signal (*see* Lesson 10).

LESSON 8.—DIRECT ATTACKER (L.M.G.—SPOTLIGHT)

Instructor's Notes

i. *Gun fitted with spotlight projector, magazines. Diagrams of diving and climbing aeroplanes pasted on all four walls of the barrack room or place of parade.*

ii. *Gun should not be more than* 10 *yards from all diagrams, if possible.*

iii. *The projector will be focused and registered before the lesson* (see *Appendix I*). *Any suitable rest, such as an aiming rest, may be used for focusing. In order not to disturb the registration, the working parts of the light machine gun will be left forward throughout the lessons.*

iv. *This lesson is intended to give training in hosepipe firing, e.g. using tracer. It may also be used to give training to gunners who will not have tracer, but in such event the gun should be fired from the shoulder and the sights used. Rules for aiming as for the rifle.*

1. Explain that the lesson deals primarily with firing at diving aircraft, and is also applicable to climbing aircraft, with the L.M.G. by the hosepipe method. Question squad on the hosepipe method and on the firing positions.

2. Explain and demonstrate :—

"Aircraft action"—"Aircraft front" etc.—"Rapid fire"—"Stop."

Emphasize that, on the order "Rapid fire," fire must be continuous until the order "Stop" is given or the aircraft is out of range. The firer's concentration must be on the target throughout, and the fire applied by observation of the spotlight near it. The spotlight is taking the place of the tracer.

3. Practise squad firing by word of command at aircraft diving and climbing from all directions. Discuss the actions of the firer and the application of fire.

LESSON 9.—THE CROSSING AEROPLANE (L.M.G.—SPOTLIGHT)

Instructor's Notes

i. *Gun with spotlight projector, magazines, model aeroplane* (see *Appendix I*).

ii. *Gun, with magazine on, will be* 10 *yards from the centre of of the run of the moving aeroplane.*

iii. *Focus and register before the lesson* (see *Appendix I*).

iv. *As for paragraph iv. Instructor's Notes, Lesson* 8.

v. *Practice in judging the half lead may be given by the instructor positioning the firer near one end of the run of the model aeroplane. The first half of the run only can be used.*

1. Practise each man in judging the lead from a stationary model aeroplane. Order the man to direct the gun at a point which he estimates to be the correct lead in front of the aeroplane and along its line of flight, and say " On ". Then press the switch and check by means of the position of the spot of light in relation to the nose of the aeroplane.

2. Firing

Explain and demonstrate at moving model :—

" Aircraft action "—" Aircraft front "—" Rapid fire " —" Stop." Fire must be continuous until the command " Stop " is given or the aeroplane is out of range. The firer's concentration must be on the target throughout, the swing being checked or increased, according to the observation of the spotlight, in relation to the nose of the aeroplane.

3. Practise squad. During the practice watch the spot of light projected when the trigger is pressed in relation to the nose of the aeroplane, and any corrections made by the firer. At the conclusion of firing discuss the firer's position and actions.

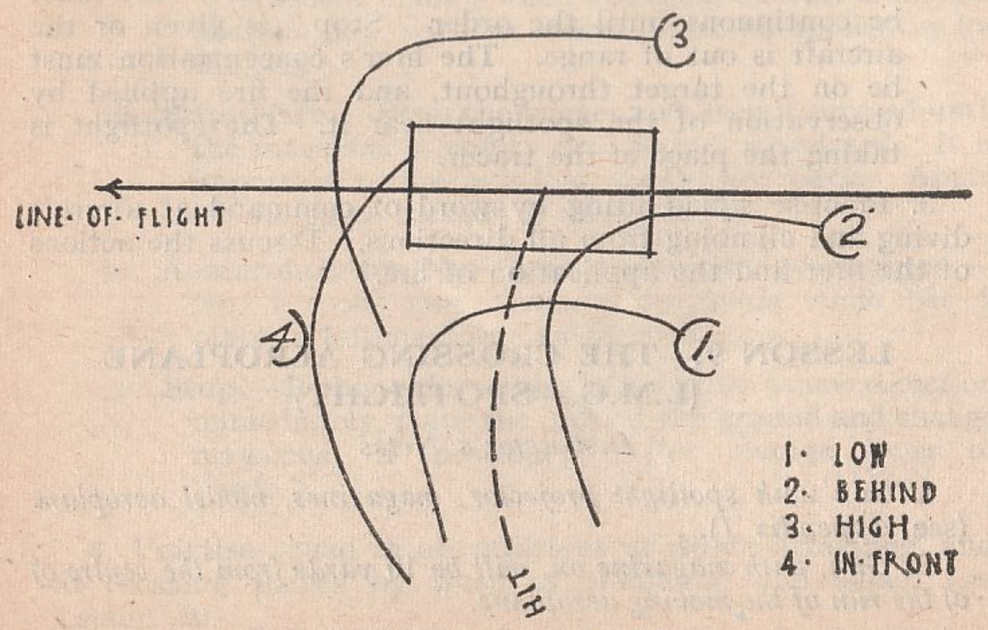


FIGURE 8.—Appearance of tracer.

LESSON 10.—FIRE DISCIPLINE TRAINING

Instructor's Notes

i. *This lesson should be regarded as the culmination of the training of the section against hostile aircraft when on the move.*

ii. *As the L.M.G. may be with the section on the march, it will be included in this lesson. A magazine will be on the gun, but the gun will not be loaded.*

iii. *Advantage should be taken of aircraft flying as targets. When such are not available, the line of flight of an imaginary aircraft will always be indicated.*

iv. *The lesson will be taught initially as a drill, but it should be repeated frequently under the most realistic conditions possible during platoon, etc., training, when the sections are marching together as a platoon.*

v. *Practice will be carried out in all normal march formations.*

1. Explain :—i. The section, or corresponding sub-unit, will be the fire unit unless further dispersion into groups of three or four becomes necessary.

ii. Section commanders, or officers, N.C.Os., or men directing the fire of a group will not normally fire themselves ; they will place themselves where they can best exercise control compatible with concealment.

iii. Whenever possible, fire control will be by word of command, but owing to noise, etc., verbal control will at times be difficult and, therefore, signals will be required. It may be necessary to use the whistle to draw attention to signals.

iv. Fire unit commanders must realize that the head-on shot is by far the easiest and most effective target, whereas the going-away or crossing shot is not so satisfactory (*see* Section 8, 1, page 6).

v. The speed at which attacks develop and the short time during which an aircraft is within range. The road should be avoided and dispersion to the nearest immediately available cover, e.g. ditch, etc., must take place instantly. Dispersal to cover must never preclude the rapid opening of fire or the correct handling of weapons from the cover selected.

2. Explain that, on receiving warning of an impending air attack the following procedure will be carried out :—

i. Fire unit commander orders " Aircraft action." The men double to the nearest immediate available cover and act as taught. The light machine gunner cocks

the gun. He must not mask or endanger the riflemen, and this risk may necessitate his being a little apart from the rest of the section.

ii. Fire unit commander orders "Aircraft front"—("about"—"left"—"right"—according to the direction of the target) and points at the target—"Rapid fire," and cuts hand to side. Men act as taught.

iii. "Stop." The order and signal (hand waved across the body) will be given before a new target or direction is indicated.

iv. "Charge magazines." The man is responsible for keeping his magazine charged whilst engaging aircraft. The fire unit commander will only give the order "Stop—charge magazines" when the particular attack has definitely stopped. Men charge magazines as taught (L.M.G.—clear gun, place a full magazine on), sling arms and reform.

3. Practise squad from all formations at the halt.

4. Signals

i. Question squad on the duties of air sentries (section 4, page 4).

ii. Explain and demonstrate the following signals :—

Enemy aircraft in sight.—A succession of short blasts on the whistle. Since the signal may often be inaudible, a visual signal will also be used, viz., both arms raised above the head and the hands waved.

Enemy aircraft attack ended.—Two long blasts on the whistle repeated at intervals of five seconds.

5. Practise squad from all formations on the move.

APPENDIX I

APPARATUS AND ACCESSORIES

1. The following equipment is required in connection with anti-aircraft training :—

i. Silhouette models and diagrams of aircraft.
ii. 12 degree lead and the six degree or half lead measurements.
iii. Model aeroplane with pole and stand.
iv. Spotlight projector.
v. Moving target for use with the spotlight projector.

2. **Silhouette model diagrams.**—Silhouette model diagrams should be affixed to walls of barrack rooms or the places of parade selected for anti-aircraft training. They should be placed at a height which will permit the man under instruction to aim and fire at them while maintaining the safety angle of 25 degrees. The diagrams should all be approximately the same distance from the firer. Diagrams should be mounted on plywood to give a white surround of approximately nine inches.

3. **Six degree and 12 degree lead measurements.**—

i. The lateral distance which 12 degrees subtends at the following distances should be marked on one of the outside walls in barracks as follows (*see* Figure 9) for six degree measurements halve the lateral distances :—

Range	6-degree Lateral distance	12-degree Lateral distance
10 yards	3 feet 6 inches	6 feet 8 inches
30 yards	9 feet 8 inches	19 feet 3 inches

A permanent mark should be fixed into the ground at the place from which the distance was measured, i.e. 10 yards and 30 yards.

ii. At 100 yards two marks of sufficient height to show the lateral distance, i.e. 63 feet 9 inches, against a sky background should be arranged (*see* Figure 10).

iii. At longer ranges the lateral distance subtended by six degrees and 12 degrees should be clearly marked by poles on the stop-butt of the classification range, or in the vicinity of barracks, in order to appear against a sky background (*see* Figure 11).

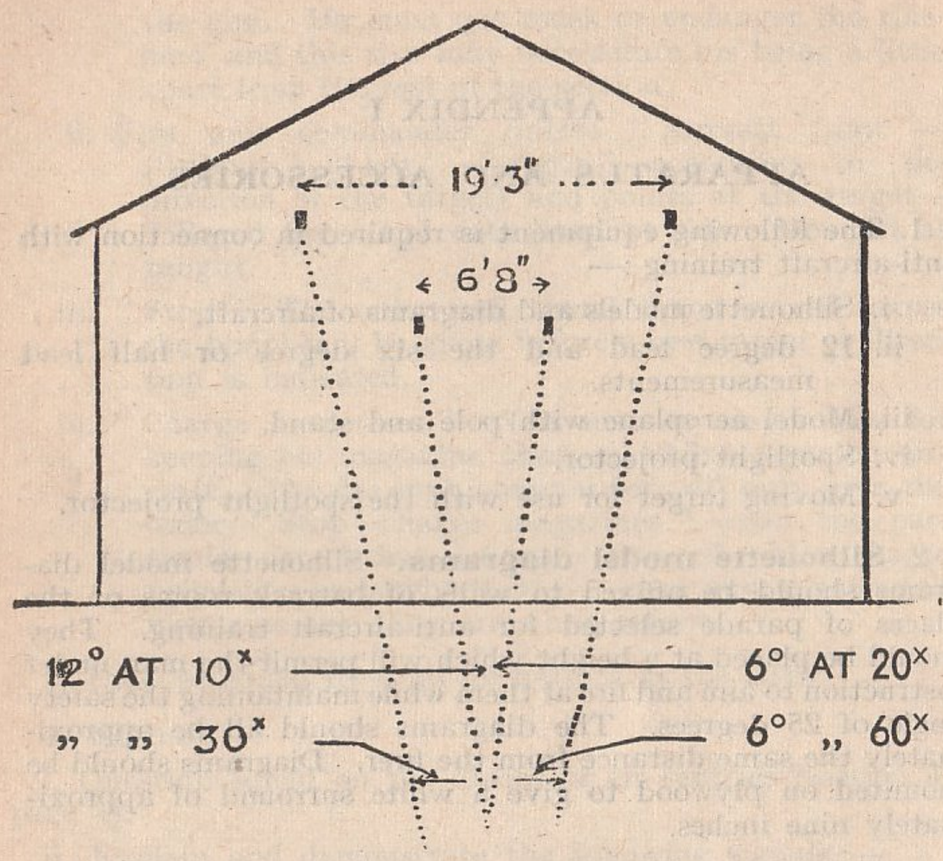


FIGURE 9.—12 degree lead marks on wall of building.

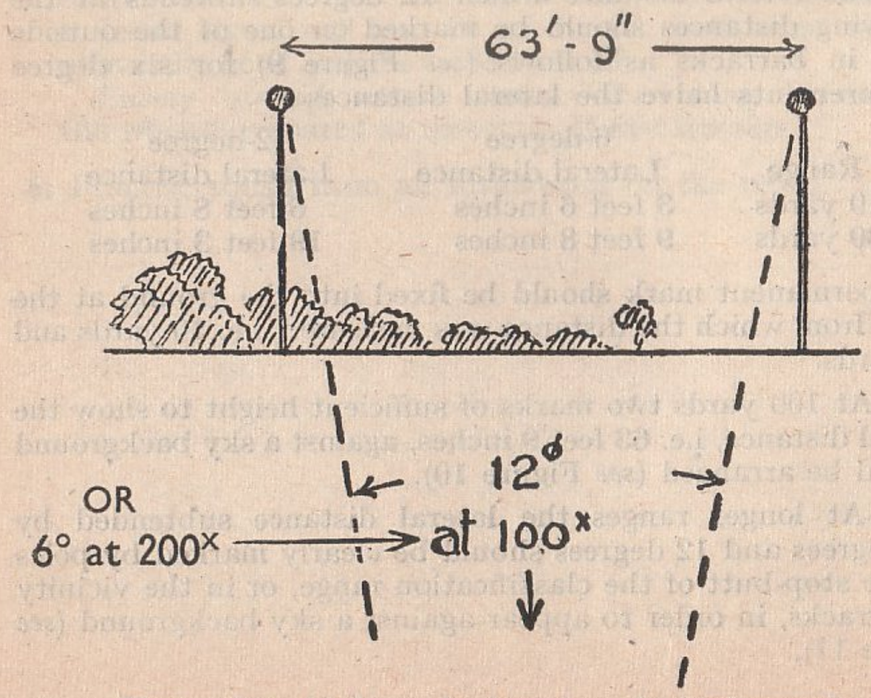


FIGURE 10.—12 degree lead marks—sky background.

Place		Range	Lateral distance
Classification range	..	300 yards	191 feet
or			
Vicinity of Barracks	..	400 yards	255 feet

12° MEASUREMENT ON A RIFLE RANGE

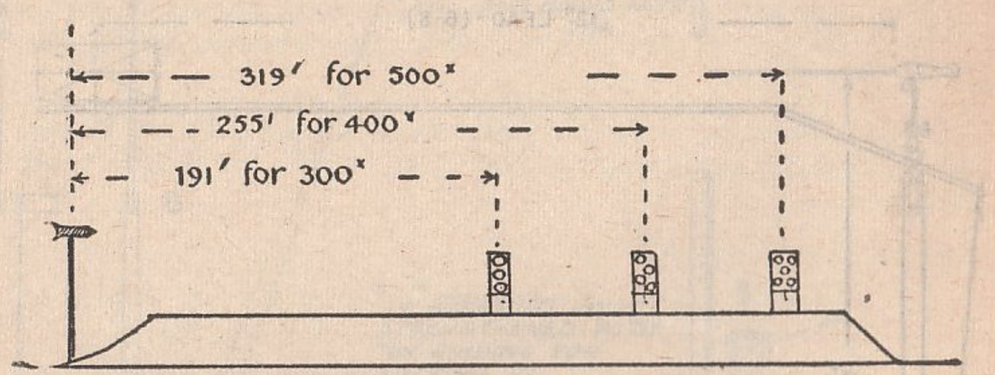


FIGURE 11.—12 degree measurements on a rifle range.

4. **Model aeroplane with pole and stand, Type "A."**—General description :—

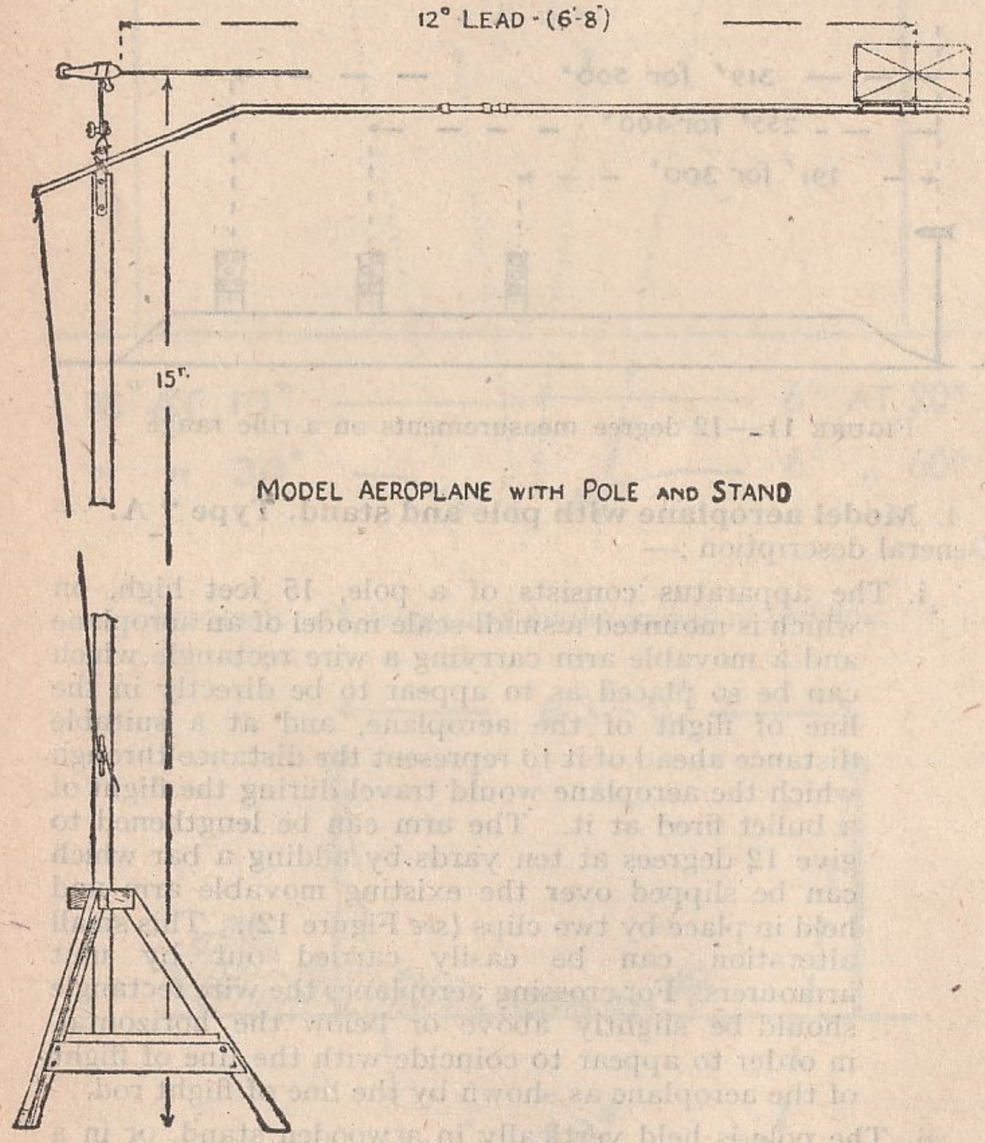
i. The apparatus consists of a pole, 15 feet high, on which is mounted a small-scale model of an aeroplane and a movable arm carrying a wire rectangle which can be so placed as to appear to be directly in the line of flight of the aeroplane, and at a suitable distance ahead of it to represent the distance through which the aeroplane would travel during the flight of a bullet fired at it. The arm can be lengthened to give 12 degrees at ten yards by adding a bar which can be slipped over the existing movable arm and held in place by two clips (*see* Figure 12). This small alteration can be easily carried out by unit armourers. For crossing aeroplanes the wire rectangle should be slightly above or below the horizontal, in order to appear to coincide with the line of flight of the aeroplane as shown by the line of flight rod.

ii. The pole is held vertically in a wooden stand, or in a hole or socket in the ground.

iii. The pole is made of stout bamboo, or two inches by two inches scantling of sufficient length to ensure that the nose of the aeroplane, when in the horizontal position, is 15 feet above ground level.

iv. The aeroplane model is fixed on a spike on top of the pole. This spike is connected to the pole through an adjustable two-way knuckle joint fitted with bolts and wing nuts.

v. The spike can be inclined at any angle within wide limits and the aeroplane may be slewed round on



MODEL AEROPLANE WITH POLE AND STAND

FIGURE 12.

the spike in such a way as to appear to be flying towards or away from the firer at any desired angle. The movable arm and rectangle, when in use, must always be at right angles to the firer's line of sight.

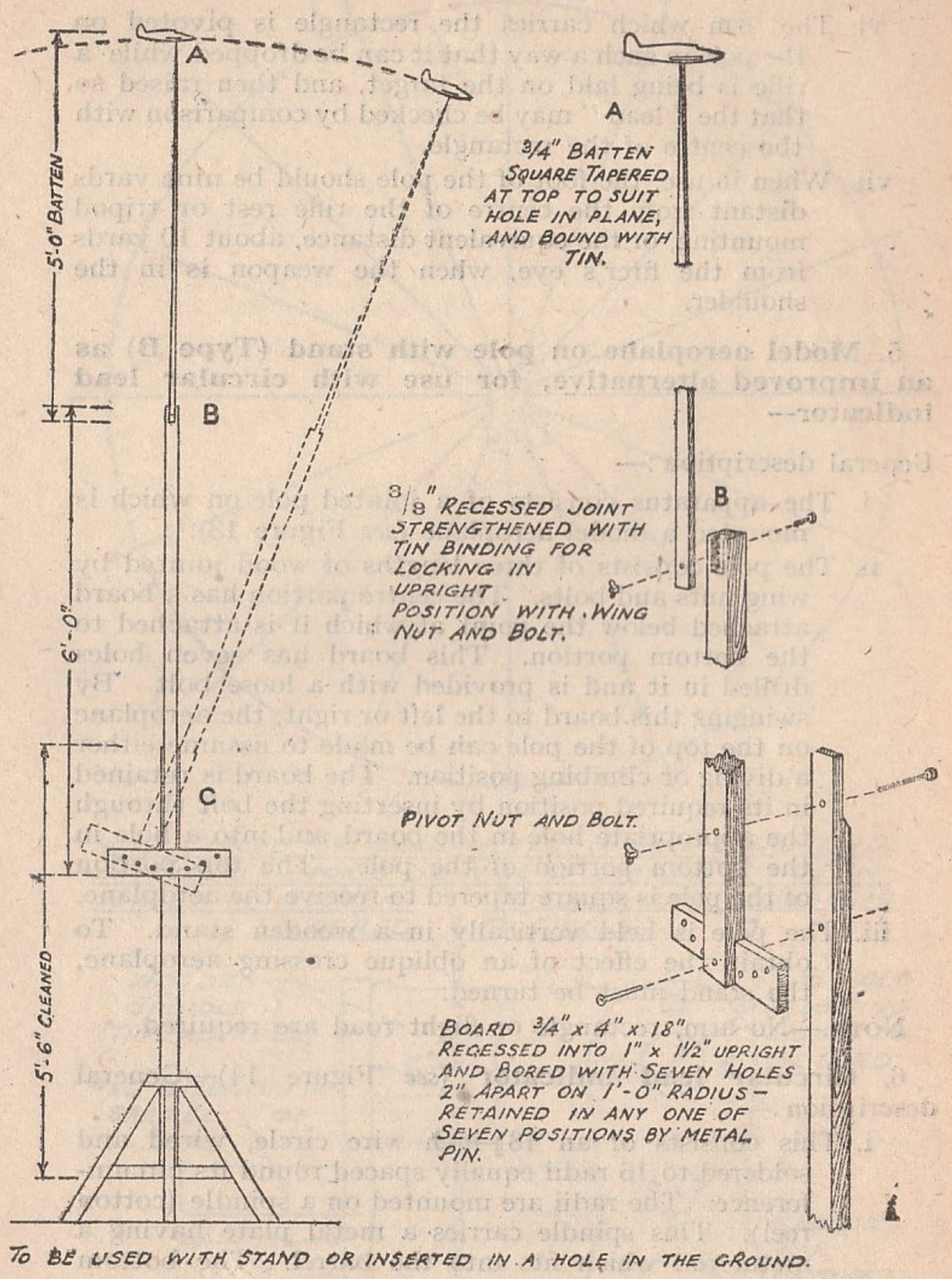


FIGURE 13.

(*See* note to Figure 14.)

vi. The arm which carries the rectangle is pivoted on the pole in such a way that it can be dropped while a rifle is being laid on the target, and then raised so that the " lead " may be checked by comparison with the centre of the rectangle.

vii. When in use, the foot of the pole should be nine yards distant from the centre of the rifle rest or tripod mounting, or the equivalent distance, about 10 yards from the firer's eye, when the weapon is in the shoulder.

5. **Model aeroplane on pole with stand (Type B) as an improved alternative, for use with circular lead indicator—**

General description :—

i. The apparatus consists of a jointed pole on which is mounted a model aeroplane (*see* Figure 13).

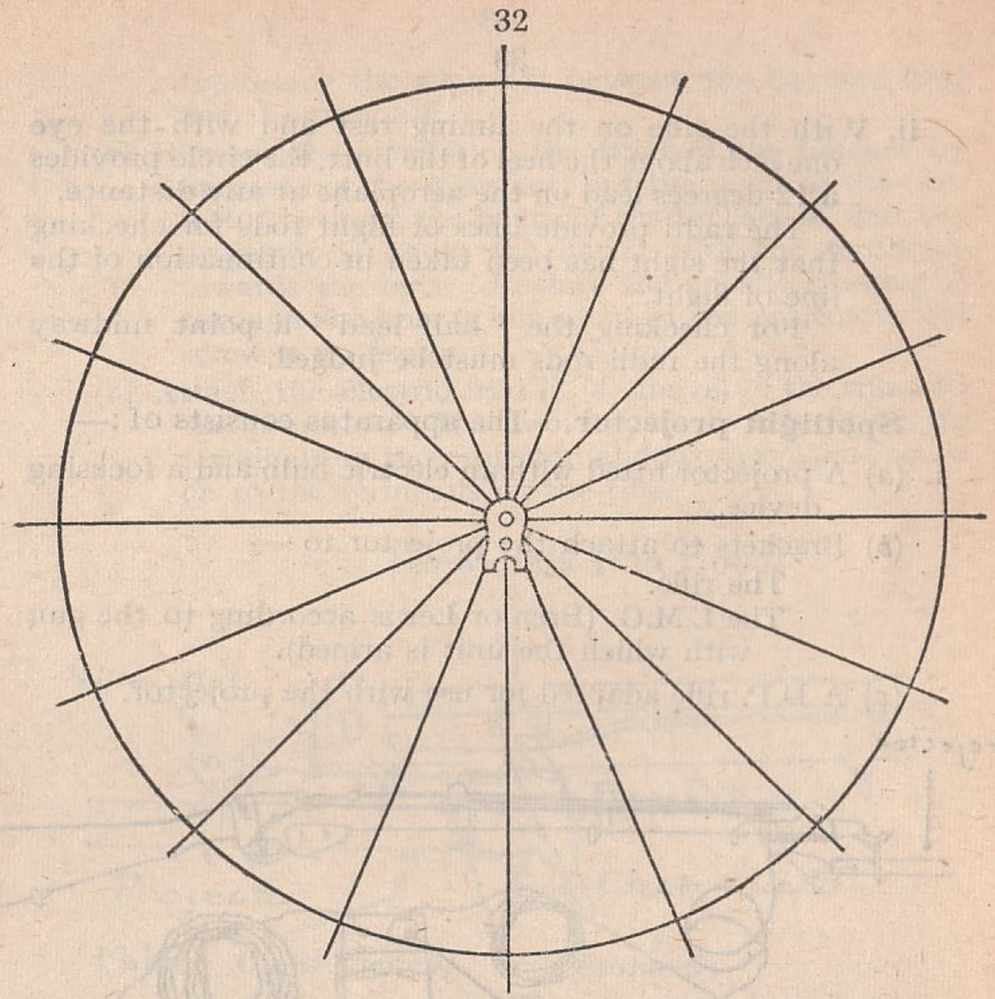
ii. The pole consists of three lengths of wood jointed by wing nuts and bolts. The centre portion has a board attached below the point at which it is attached to the bottom portion. This board has seven holes drilled in it and is provided with a loose bolt. By swinging this board to the left or right, the aeroplane on the top of the pole can be made to assume either a diving or climbing position. The board is retained in its required position by inserting the bolt through the appropriate hole in the board, and into a hole in the bottom portion of the pole. The top portion of the pole is square tapered to receive the aeroplane.

iii. The pole is held vertically in a wooden stand. To obtain the effect of an oblique crossing aeroplane, the stand must be turned.

NOTE.—No arm, rectangle or flight road are required.

6. **Circular lead indicator** (*see* Figure 14)—General description :—

i. This consists of an 18½-inch wire circle, wired and soldered to 16 radii equally spaced round its circumference. The radii are mounted on a spindle (cotton reel). This spindle carries a metal plate having a metal rod which fits into the barrel. The bottom of the plate is cut to fit over the bayonet boss in such a manner that, when the rod is in the barrel, the centre of the circle coincides with the line of sight. The plate and spindle have a ½-inch hole drilled at this point to allow the sights to be used.



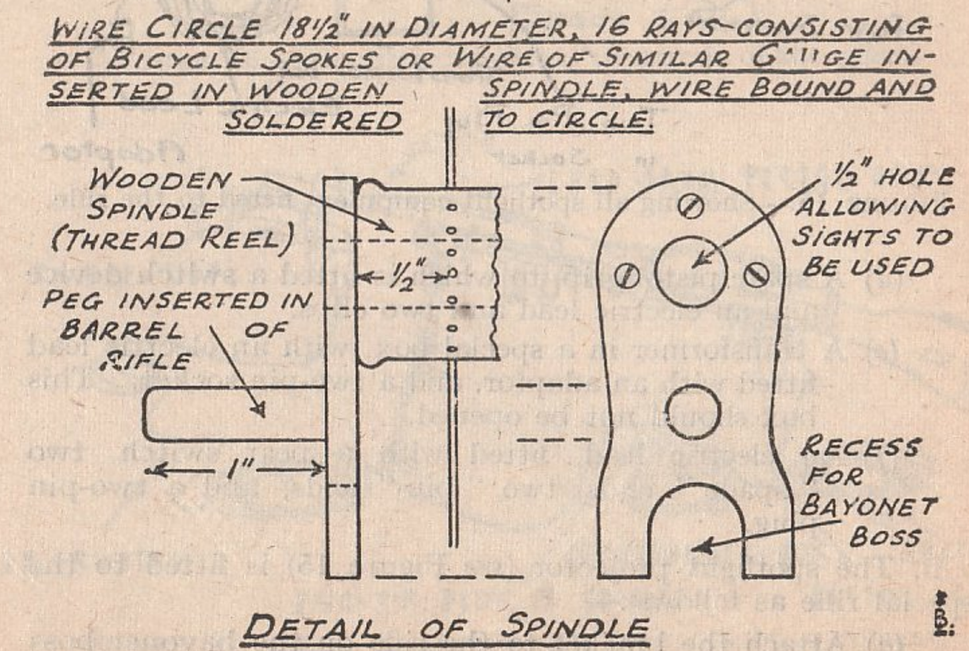


FIGURE 14.

NOTE.—With the exception of the diameter of the circle which must be adhered to the measurements given for Figures 13 and 14 are a guide to construction and can be varied to suit material available.

ii. With the rifle on the aiming rest and with the eye one inch above the heel of the butt, the circle provides a 12-degrees lead on the aeroplane at any distance.

The radii provide lines of flight rods for checking that the sight has been taken in continuation of the line of flight.

For checking the "half lead" a point midway along the radii rods must be judged.

7. Spotlight projector. The apparatus consists of :—

i. (*a*) A projector fitted with an electric bulb and a focusing device.

(*b*) Brackets to attach the projector to :—

The rifle.

The L.M.G. (Bren or Lewis according to the gun with which the unit is armed).

(*c*) A D.P. rifle adapted for use with the projector.

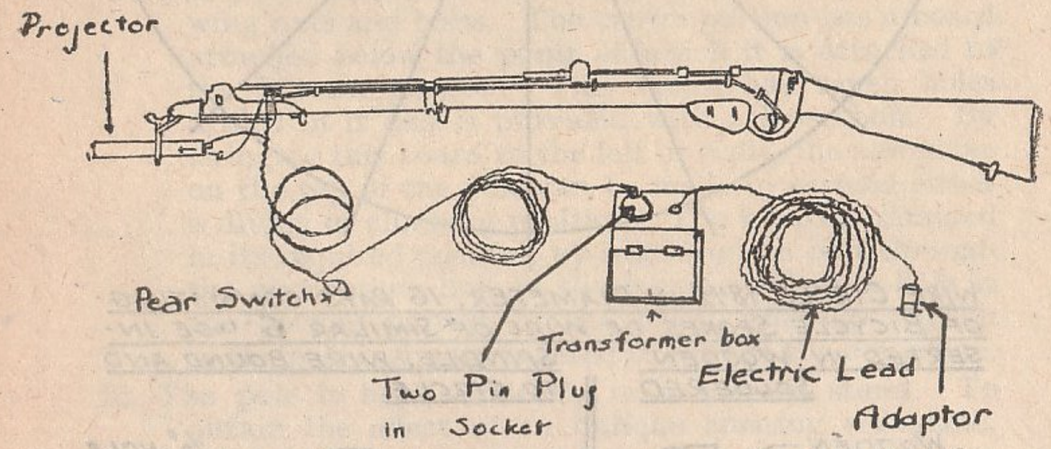


FIGURE 15.—Showing all spotlight equipment fitted to the rifle.

(*d*) A spare pistol grip, to which is fitted a switch device and an electric lead and two clips.

(*e*) A transformer in a special box, with an electric lead fitted with an adaptor, and a two-pin socket. This box should not be opened.

(*f*) An electric lead, fitted with a pear switch, two "spade" ends, two "pin" ends, and a two-pin plug.

ii. The spotlight projector (*see* Figure 15) is fitted to the special rifle as follows :—

(*a*) Attach the bracket to the rifle on the bayonet boss and standard. Clamp the bracket firmly by

tightening the wing nut between the bayonet boss and the standard.

(*b*) Remove the spindle on the front of the bracket by unscrewing the wing nut, put the pivot of the projector between the wings of the bracket so that the projector is under the barrel with the terminals towards the butt. Replace the spindle, passing it through the hole in the pivot of the projector, and screw it up firmly.

(*c*) Attach the electric lead (i. (*f*) above) to the rifle and the projector. The two "spade" ends fit on to terminals on the projector, and the two "pin" ends on to the terminals on the rifle.

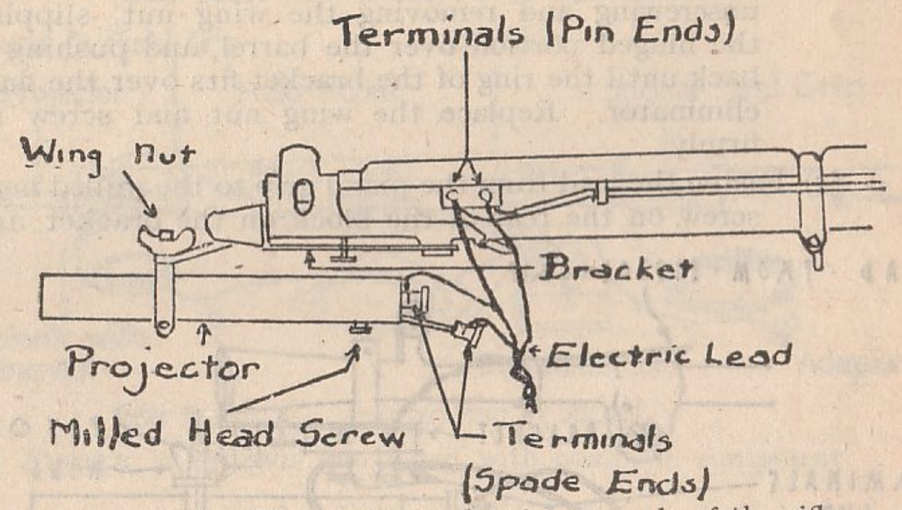


FIGURE 16.—The projector fitted to muzzle of the rifle.

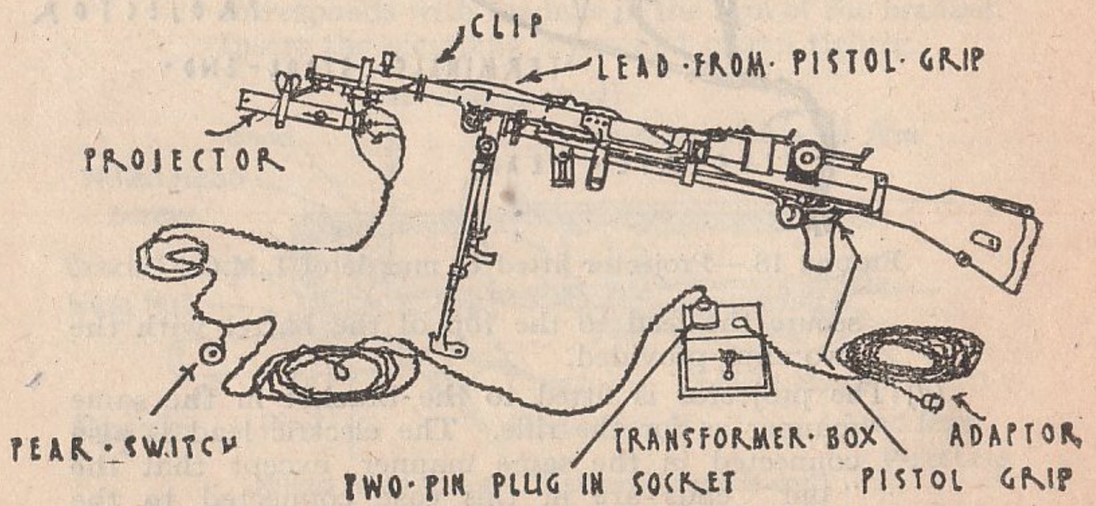


FIGURE 17.—L.M.G. fitted with complete spotlight equipment.

(*d*) Insert the two-pin plug into the socket on the transformer box.

(*e*) Having first ascertained that the controlling switch is off, remove the bulb from a convenient electric light, and insert the adaptor of the transformer. Switch on the current to the light, and the projector is ready for use. When the trigger is pressed or the pear switch is operated, a spot of light will be projected from the projector.

iii. The spotlight is fitted to the Bren gun as follows (*see* Figure 17) :—

(*a*) The attachment is fitted to the pistol grip.

(*b*) Attach the bracket to the muzzle of the Bren gun by unscrewing and removing the wing nut, slipping the hinged portion over the barrel, and pushing it back until the ring of the bracket fits over the flash eliminator. Replace the wing nut and screw up firmly.

(*c*) Fasten the lead from the pistol grip to the milled head screw on the rear of the block on the bracket, and

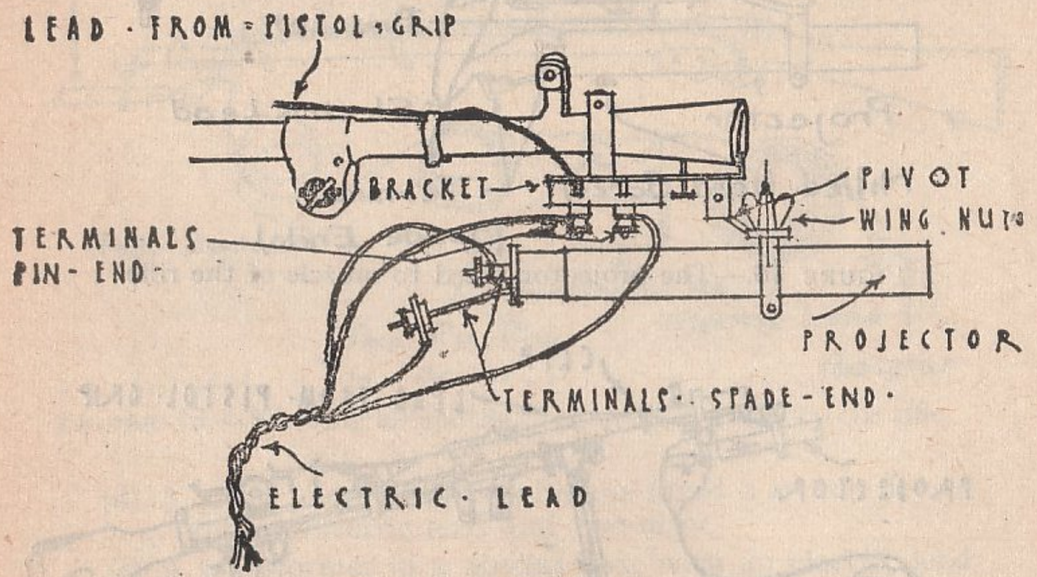


FIGURE 18.—Projector fitted to muzzle of L.M.G.

secure the lead to the top of the barrel with the two clips provided.

(*d*) The projector is fitted to the bracket in the same manner as for the rifle. The electric lead is also connected in the same manner, except that the "pin" ends are in this case connected to the terminals on the bracket.

(*e*) Continue as in ii. (*d*) and (*e*) above (*see* Figure 18).

iv. The spotlight projector is fitted to the Lewis gun as follows :—

(*a*) Replace the pistol grip on the gun with the special pistol grip issued for the spotlight projector.

(*b*) Attach the spotlight projector bracket to the gun as follows :—

Insert the small end of the arm of the bracket under the sling swivel from the front so that the wings point towards the muzzle and the thickened portion of the small end is towards the radiator casing. Unscrew the clamping screw of the band and slide the band, with the heads of the two

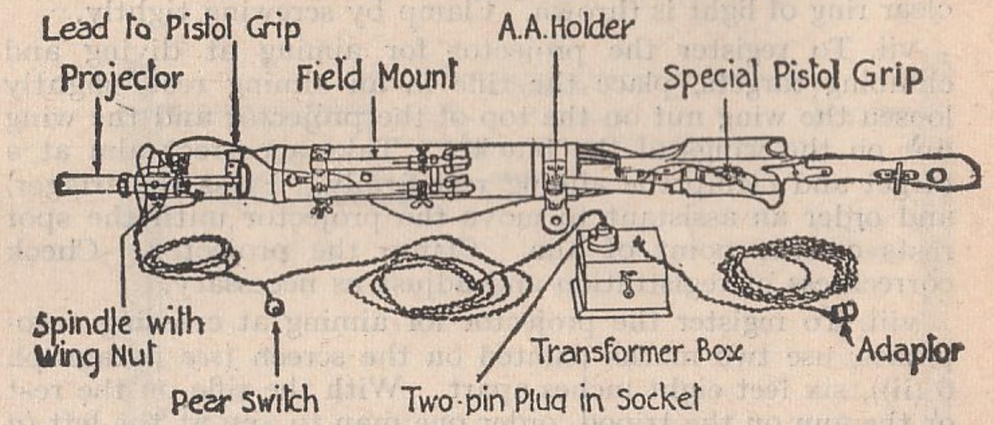


FIGURE 19.—Lewis gun fitted with complete equipment.

terminals towards the butt, over the front radiator casing, pushing it back until the hole in the band corresponds with the hole in the arm of the bracket. Insert the clamping screw and clamp tightly.

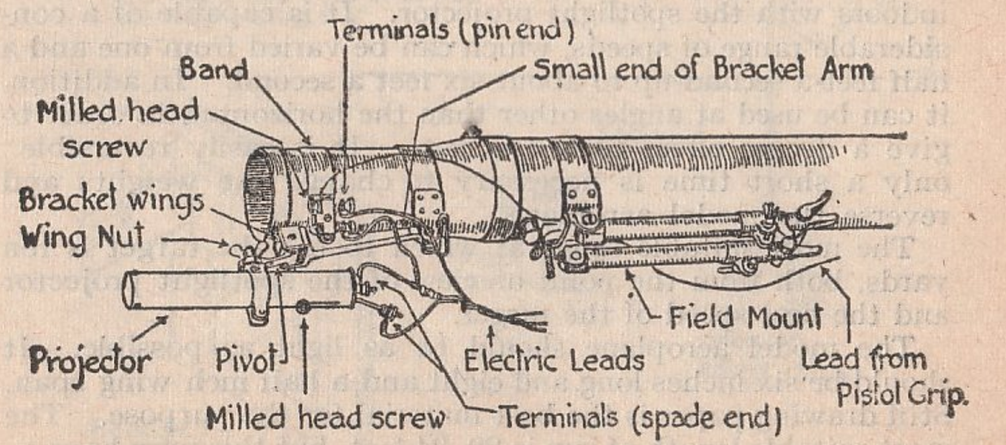


FIGURE 20.

(*c*) Pass the lead from the trigger under the band of the anti-aircraft holder and the field mount, and attach it to the milled head screw on the front of the block on the bracket.

(*d*) As in iii. (*d*) above.

(*e*) Continue as in iii. (*d*) and (*e*) above (*see* Figure 20).

v. The transformer is issued complete in its box with all necessary connections made. No alterations will be made to the internal wiring of the box. Any necessary repairs must be made by an electrician.

vi. To focus the light from the projector, unscrew the small milled head screw under the barrel of the projector a few turns, and slide it backwards and forwards until a small clear ring of light is thrown. Clamp by screwing tightly.

vii. To register the projector for aiming at diving and climbing targets, place the rifle in an aiming rest, slightly loosen the wing nut on the top of the projector and the wing nut on the wings of the bracket. Take a correct aim at a target and clamp the aiming rest firmly. Press the trigger, and order an assistant to move the projector until the spot rests on the point of aim. Clamp the projector. Check correctness of registration and adjust as necessary.

viii. To register the projector for aiming at crossing aeroplanes, use two marks painted on the screen (*see* paragraph 6 (ii)), six feet eight inches apart. With the rifle on the rest or the gun on the tripod, order one man to aim at the left of the two marks and then register the light on the right-hand mark as in vii. above. The centre of the rest or tripod to be 10 yards from the screen.

8. **Moving target for spotlight projector** (*see* Figure 21).

i. The target described below has been designed for use indoors with the spotlight projector. It is capable of a considerable range of speeds, which can be varied from one and a half feet a second up to about six feet a second. In addition, it can be used at angles other than the horizontal, in order to give a diving effect to the target. It is easily reversible; only a short time is necessary to change the weights and reverse the model aeroplane.

The most suitable range at which to use the target is ten yards, both from the point of view of the spotlight projector and the best speed of the target.

The model aeroplane should be as light as possible. It should be six inches long and eight and a half inch wing span. Stiff drawing paper is the best material for the purpose. The most suitable length of run is 20–24 feet, but this may have to

be shortened when the run is not horizontal if insufficient vertical drop is available at one end of the run.

ii. **Description of target.**—Two front wheel hubs and spindles of an ordinary bicycle form the pulleys for the target. The oiling caps are removed. Round blocks of wood, with holes of the same diameter as that of the hubs of the wheels bored through their centres, are halved and glued in position on one half of the hubs. Three screws through the spoke holes retain the blocks in their correct positions. The pulleys are then turned on a lathe to the shape and dimensions shown in Figure 21.

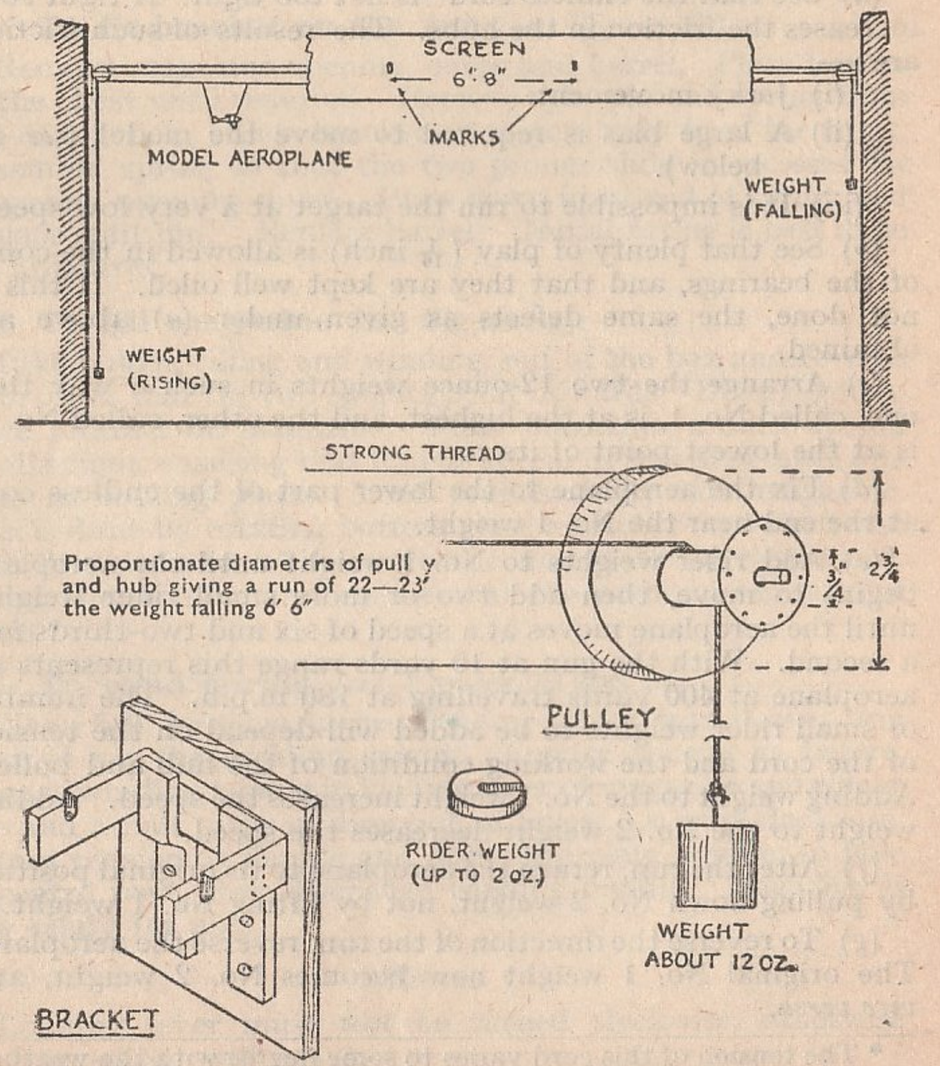


FIGURE 21.—Moving target for spotlight projector.

The hubs are set opposite to one another in brackets. An endless cord of mattress thread is run round the two wooden pulleys, and the model aeroplane is hung on the lower thread. A second cord, also of mattress thread, is run over the metal part of the hubs, with two weights of 12 ounces, each hung at either end of the cord. The length of this cord should be so adjusted that, when one weight is resting on the ground, the other is against the stop close to the pulley.

A complete turn should not be taken round the hub with the weight cord; this introduces friction, and is quite unnecessary.

Screens should be erected in front to hide the mechanism and track, and behind to show up the spot.

iii. **Method of using target.**—

(*a*) See that the endless cord* is not too tight. A tight cord increases the friction in the hubs. The results of such friction are :—

(i) Jerky movement.

(ii) A large bias is required to move the model (*see* (*e*) below).

(iii) It is impossible to run the target at a very low speed.

(*b*) See that plenty of play ($\frac{1}{16}$ inch) is allowed in the cones of the bearings, and that they are kept well oiled. If this is not done, the same defects as given under (*a*) above are obtained.

(*c*) Arrange the two 12-ounce weights in such a way that one, called No. 1, is at the highest, and the other, called No. 2, is at the lowest point of its run.

(*d*) Fix the aeroplane to the lower part of the endless cord at the end near the No. 1 weight.

(*e*) Add rider weights to No. 1 weight until the aeroplane begins to move, then add two or more small rider weights until the aeroplane moves at a speed of six and two-thirds feet a second. With the gun at 10 yards range this represents an aeroplane at 400 yards travelling at 180 m.p.h. The number of small rider weights to be added will depend on the tension of the cord and the working condition of the hub and pulley. Adding weight to the No. 1 weight increases the speed. Adding weight to the No. 2 weight decreases the speed.

(*f*) After the run, return the aeroplane to its original position by pulling down No. 2 weight, not by lifting No. 1 weight.

(*g*) To reverse the direction of the run, reverse the aeroplane. The original No. 1 weight now becomes No. 2 weight, and *vice versa*.

* The tension of this cord varies to some degree with the weather.

APPENDIX II

EQUIPMENT FOR 100-ROUND MAGAZINE

1. Equipment for 100-round magazine consists of :—

i. Bracket to fit on gun.
ii. Four 100-round magazines.
iii. Holder, filling and winding.
iv. One winding handle.
v. Box containing above.

(Each gun in A.A. platoon of H.Q. company has one set of above equipment.)

2. **To fit bracket on the gun** (*see* Figure 22).

Remove magazine opening, cover and barrel. Place former in the chest until required. Remove split pin and spring from top of bracket. Slide bracket on to gun body from the front. Assemble spring so that the two prongs slide in recesses for magazine opening cover. Press down front end of spring and replace split pin. Replace barrel. Initial fitting is best done by armourer.

3. **To fill magazine** (*see* Figure 24).

Take holder, filling and winding, out of the box and reverse it, in order that the two spigots point upwards. Disengage top plate retainer on magazine. Place magazine, mouth up, on small spigot, ensuring that tongue at rear of mouth of magazine rests in holding plate. Load rounds singly into magazine. This is done by rotating bottom plate assembly anti-clockwise with the left hand, while inserting rounds with the right hand. Count the rounds, and ensure that the ammunition is kept clean.

4. **To wind spring** (*see* Figures 23 and 24).

When full, take magazine off filling spigot, turn it over, and place it on the winding spigot. Engage tongue as before. Engage winding handle in loading lever of magazine and rotate five and a half turns in direction of arrow, i.e. anti-clockwise. Retain tension on handle and insert top plate retainer in hole in centre post, then disengage winding handle. Magazine is now ready for use.

NOTES

1. Loading lever must **not** be turned clockwise, otherwise the spring will break.

2. Five and a half turns is approximate figure. Individual magazines may require half a turn more or less. Conditions of temperature, etc., may also cause variation.
3. When not in use ease tension. Place magazine on winding spigot, place winding handle in loading lever of magazine, disengage top plate retainer, ease tension of spring under control by means of winding handle, then rewind half a turn and relock top plate retainer. Before use do not forget to wind completely five and a half turns, i.e. another five turns. It is suggested that, on service, during the night is the only possible time to ease the tension.

5. Placing of magazine on, and removal from gun

Hold magazine with hand through webbing handle—point the front down and place tongue in recess in front of bracket. Press magazine down until engaged in magazine catch. To remove, press in magazine catch and lift magazine off.

6. To empty magazine

i. Place magazine on winding spigot and, using winding handle, remove tension from spring, leaving top plate retainer disengaged.

ii. Place magazine on filling spigot and remove rounds one at a time by rotating bottom plate assembly in a clockwise direction. When magazine is empty, rewind spring one half-turn, and engage top plate retainer.

7. Stripping, assembling, and cleaning of magazines

For cleaning, the following stripping may be carried out :—

i. See that the magazine is empty and the spring unwound.
ii. Disengage top plate retainer.
iii. Hold handle and push spring catch sideways out of engagement with centre part.
iv. Lift off inspection cover and top plate cover.
v. Turn magazine over, resting centre part on box, holding the hand over the spring and hub while so doing.
vi. Spring out top plate clip until clear and lift off bottom plate assembly. This is best done by pushing the nose of a bullet between clip and side of magazine.
vii. Clean, and assemble in reverse order.

NOTES

1. Do not attempt to remove the spring.
2. In conditions of dust and sand, magazines should be stripped and cleaned often. When on the gun but not in use, a ground sheet should be hung over the gun and the magazine. This rule applies also to bad weather—rain, snow, etc.

3. In extremes of cold weather " Oil, low cold test " must be used for lubrication, all old oil being first cleaned off with paraffin or petrol. When possible, magazines should be kept with personnel at rest or sleeping.

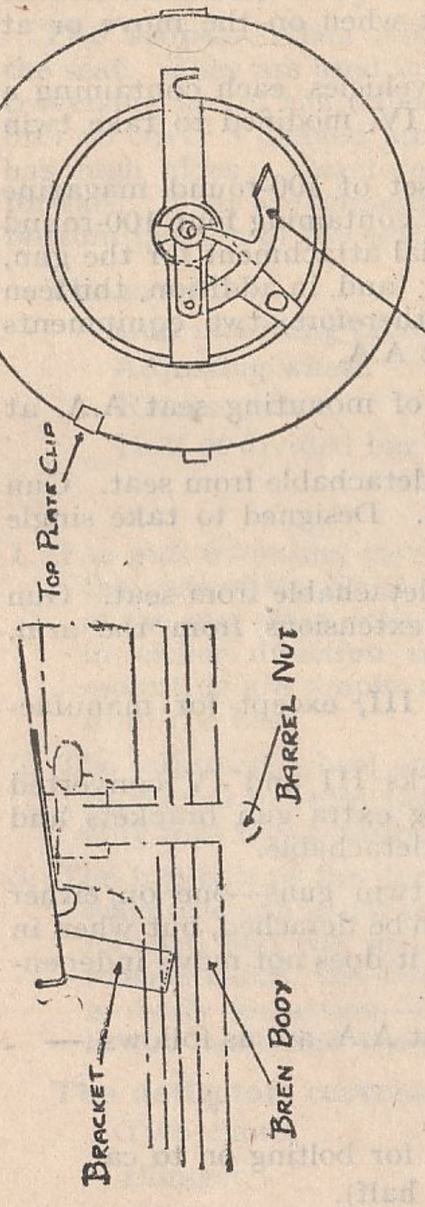


FIGURE 22.

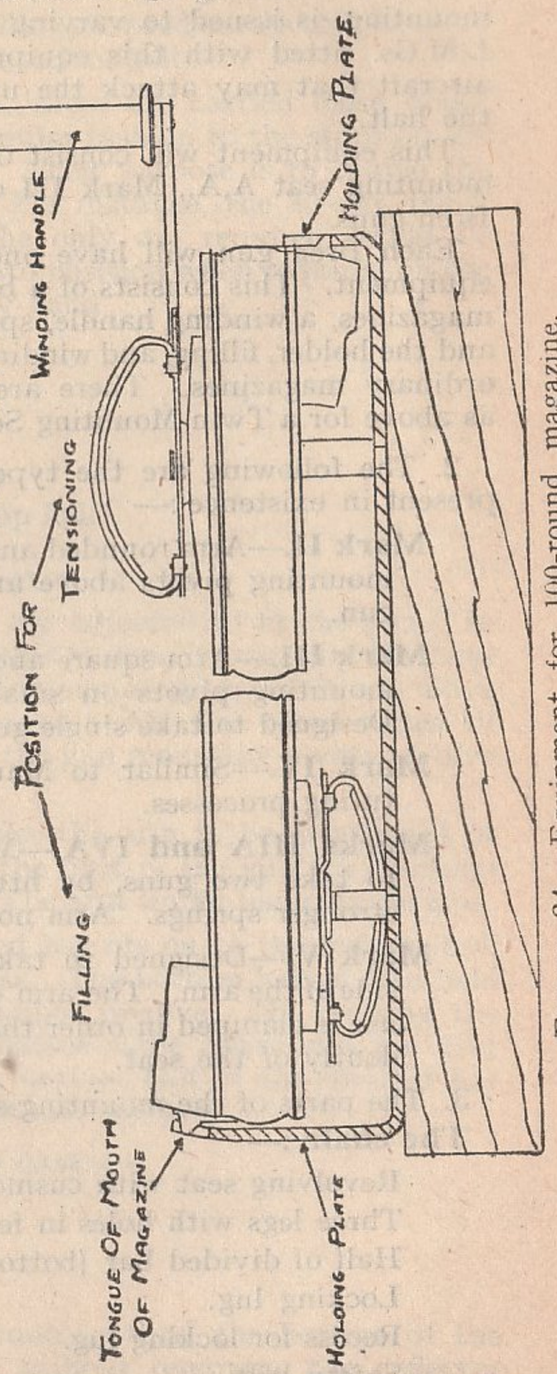


FIGURE 24.—Equipment for 100-round magazine.

FIGURE 23.

NOTE.—The Mark II magazine has the winding handle permanently attached to the loading lever.

APPENDIX III
MOUNTING SEAT A.A.

1. The mounting seat A.A., hitherto known as the Motley mounting, is issued to varying types of units. The task of L.M.Gs. fitted with this equipment is to deal with hostile aircraft that may attack the unit when on the move or at the halt.

This equipment will consist of vehicles, each containing a mounting seat A.A., Mark III or IV, modified to take twin Bren guns.

Each Bren gun will have one set of 100-round magazine equipment. This consists of a box containing four 100-round magazines, a winding handle, special attachment for the gun, and the holder, filling, and winding ; and, in addition, thirteen ordinary magazines. There are, therefore, two equipments as above for a Twin Mounting Seat A.A.

2. The following are the types of mounting seat A.A. at present in existence :—

Mark II.—Arm rounded and detachable from seat. Gun mounting pivots above arm. Designed to take single gun.

Mark III.—Arm square and detachable from seat. Gun mounting pivots on small extensions from the arm. Designed to take single gun.

Mark IV.—Similar to Mark III, except for manufacturing processes.

Marks IIIA and IVA.—Marks III and IV converted to take two guns, by fitting extra gun brackets and stronger springs. Arm not detachable.

Mark V.—Designed to take twin guns—one on either side of the arm. The arm can be detached, but when in use is clamped in order that it does not move independently of the seat.

3. The parts of the mounting seat A.A. are as follows :—

The chair :—

Revolving seat with cushion.
Three legs with holes in feet for bolting on to car.
Half of divided bar (bottom half).
Locking lug.
Recess for locking lug.
Safety belt.
Socket for fitting arm.

NOTES

1. **The locking device.**—When the divided bar is held forward, the locking lug engages in the recess on the seat and prevents it from revolving.
2. The car may often be travelling at speed across bad country, hence the necessity of the safety belt.

The stops.—When issued, these are carried loose under the seat. They are used in similar fashion to the stops on the traversing arc of the tripod. Their purpose is to enable the firer to cover a defined arc. For instance, the 30-cwt. truck has high sides ; therefore the only arc required would be forward. They are screwed into position when required on the bottom portion of the seat by hand.

The arm :—

Gun mounting pivots.
Adjusting wheel.
Release catch.
Half of divided bar (top half).

NOTES

1. The gun mounting pivots are adjusted to fit the gun. In the case of the Mark II this is done by tapping the base of the rear pivot with a hammer or spanner—it will move in either direction required. All the other types of mounting are simple, as the gun mounting pivots revolve from the base.
2. The adjusting wheel enables the arm to be lengthened or shortened in order that the butt of the gun fits comfortably into the shoulder. The arm works telescope fashion.
3. The top half of the divided bar fits on to the bottom half when the gun is not in use. The bottom half is then held forward and the seat cannot revolve. On pressing the release catch, the two halves come apart and the firer is ready for action—the bottom half of the divided bar is now back and the seat can revolve.

The deflector, cartridge case :—

Two claws.
Plunger.
Bag.

There is a zip-fastener running round the bottom of the bag, which can be emptied without removing the deflector from the gun.

Before fitting the deflector see that the ejection opening cover is open. Ease up the barrel nut—this is not absolutely necessary, but may assist. Press out the plunger with the forefinger, and, holding it in this position, place the claws over the projections beyond the ejection opening cover. Pull back and fit the rear portion of the deflector into place. Release plunger.

To remove, reverse process. Remember to press out plunger first.

4. To assemble the Mounting Seat A.A.

There are three holes in the floor of the utility car. The legs of the seat fit exactly over these holes and are screwed down from above.

When the arm is not a fixture with the seat, it is placed in the socket—sliding easily into position.

The gun is now fitted on to the gun mounting pivots. It is then adjusted to the firer by means of the adjusting wheel. The two halves of the divided bar are joined. The safety belt is adjusted. 100-round magazine is placed on the gun.

NOTE.—When this mounting is assembled in a 15-cwt. truck, a base, consisting of two iron bars, is bolted into position from underneath the truck. Running down either side of the truck are two metal strips with holes in them. The front part of the base is bolted into the fourth holes, and the rear half into the ninth holes counting back from the front of the truck (driving seat end). There are holes in the base, and the seat is screwed into position from above in exactly the same way as in the car. The reason for the base being placed so far forward is to ensure that the firer cannot lower the muzzle of the gun below the hood canopy of the vehicle and shoot the driver.

The mounting seat A.A. is taken down in the reverse order to assembly.

PART II.

ANTI-AIRCRAFT DEFENCE—RECOGNITION

12. Introduction

1. Recognition is a means to an end, and the important point in all anti-aircraft training is to fire the L.M.G. or rifle with effect against low flying enemy aircraft. This subject requires constant practice at all times. Opportunities present themselves daily and commanders should take the fullest advantage of exercising their troops in this all-important training.

2. Low flying aircraft, e.g. low level or dive-bombers, reconnaissance or, maybe, machine-gunning aircraft, if they are at ranges of 2,000 feet or below, present very suitable targets and must be engaged by small arms fire. Above this height they will be engaged by fighters, and by heavy and light anti-aircraft guns.

3. The speed of modern aircraft necessitates instant and instinctive recognition to ensure effective small arms fire. Instant recognition requires a thorough knowledge of aircraft "silhouettes" as it is by this means that a machine is first spotted. Aircraft making low-level attacks will, more often than not, present themselves "head-on," which makes recognition extremely difficult.

4. The ability to recognize aircraft correctly requires :—

i. An elementary knowledge of the features of an aeroplane.

ii. A thorough knowledge of the general appearance of an aeroplane.

iii. Continuous practice on every type of machine.

Guesswork is useless. Incomplete evidence, such as wing-shape or the number of engines alone, is not sufficient to make identification certain.

The end to be aimed at is to make the recognition of aircraft just as instantaneous and instinctive as the recognition of individuals or motor cars by means of salient recognition features.

13. Theory of aircraft recognition training

1. Recognition training must have, for its objective, the identification of an aeroplane in the minimum of time. Investigation has shown that those interested in aircraft find that recognition is second nature to them.

2. It is obvious, therefore, that training should be devised to produce this complete familiarity which results in almost immediate or " sub-conscious " recognition.

3. Experience has proved that analysis systems including the " WEFT " method are unsatisfactory.

4. Identification by familiarity (i.e. sub-conscious) does not confine the man to any one feature, view or position in particular, but rather does it allow him to " spot " the machine by its general appearance. This method has been found, from experience, to be the most satisfactory for service use **and it will be adopted forthwith.**

14. Notes on training

1. Personnel must know the types of aircraft they are likely to see under service conditions. The best way of attaining this result would be to let men see the actual aircraft in flight in every possible position until the required standard is reached. This method, however, is not often possible.

2. This difficulty can be overcome by the use of scale models, which must be accurately made as far as the main features are concerned. It is unnecessary to worry about the smaller details, but such features as the shape of the nose, engines, wings, etc., must be accurate. Whether wireless aerials or airscrews are fitted is immaterial. A convenient scale is 1/72nd (or 1 inch — 6 feet) and this, viewed at a distance of nine yards is equivalent to seeing the aircraft at 2,000 feet (approximately). Sets of these models are now being issued.

3. The chief advantages of models are :—

i. It is more economical to provide a set for every unit than to arrange for the real aircraft to fly.

ii. Operational aircraft are consequently released for other purposes.

iii. Training can be carried out irrespective of weather conditions.

iv. Training can be graded to suit the standards of personnel under instruction.

v. Training can be fitted in to suit the general programme since all arrangements are under unit control.

vi. Any particular machine can be concentrated on and repeated as often as necessary.

4. Study of these models unaided is, however, of no great value unless the efforts of the men using them are directed along the right lines. The differences between the various types of machines must be pointed out to them until they instinctively know all the details in their appearance. For this purpose large scale silhouettes are required, as these enable an instructor to point out the various features in each machine and so to impress them on the mind of every man under instruction.

5. Another very useful form of instruction is the episcope or epidiascope, by means of which pictures and photographs can be projected on to a screen. The lack of either need not decrease the value of these pictures and photographs, since it is also possible to hand them round a class and place a limit on the time allowed for recognizing each machine.

6. The important point to bear in mind throughout this training is that the man's interest must be maintained. He should not have to be forced to examine every aircraft that flies overhead but should do so instinctively because he is interested and curious to know what it is. In order to instil this interest from the start, very elementary lectures on such subjects as the " Theory of Flight ", " Aircraft Design and Construction ", and " Features of an Aeroplane " may be given. An instructor who can give these lectures in an interesting and enthusiastic manner will give his men the incentive for study in their spare time, without their realizing that they are working " overtime."

7. Other forms of instruction which will keep men interested and amused are :—

i. Silhouette playing cards.

ii. Recognition tests.

iii. Model making.

iv. The compilation of a scrap book.

v. Blackboard drawing competitions.

8. Training films are also available and these will be of the greatest value if they are shown subsequent to lectures and other instruction. They are insufficiently complete to cover the subject fully, but they make an excellent finale to any instruction given in the particular lesson with which they deal.

9. Ingenuity in improvisation can achieve a very great deal in the absence of official equipment, and it should be encouraged at all times.

10. To obtain the best results, lessons should be of a reasonably short duration, but should be carried out at regular intervals.

15. Sequence of instruction

1. Instruction should commence with the introductory lectures referred to in Section 14, paragraph 6. (Notes to assist instructors are given in Appendices A-C.) Thereafter, it is a matter of dealing with each aircraft in detail so as to ensure that no important recognition feature is missed.

2. In deciding on the number and types of aircraft to be included in the syllabus, it must be remembered that both the enemy and ourselves are continually producing new aircraft. It will, therefore, not be possible to include other than the more important types, which have definitely proved their worth and are likely to remain in service.

3. The guiding principle should be to keep the number down to a minimum and to select those machines which are most likely to be encountered in the unit area. All ranks must be taught to recognize these machines instinctively and to keep themselves up-to-date by a close study of the silhouettes, books, and pamphlets which are issued from time to time.

4. Below is given, *as a guide only*, a list of the aircraft which might be included in the syllabus of a unit stationed at home :—

British	*German*
Spitfire.	Messerschmitt 109.
Hurricane.	Messerschmitt 110 (including Jaguar).
Beaufighter.	

British	*German*
Defiant.	Junkers 52.
Whirlwind.	Junkers 87.
Buffalo.	Junkers 88.
Airacobra.	Junkers 89/90.
Mohawk.	Dornier 17.
Tomahawk.	Dornier 215.
Lysander.	Heinkel 111
Blenheim, Marks 1 and 4.	Henschel 126.
Wellington.	Focke-Wulf 187.
Whitley.	Focke-Wulf 200 K.
Hampden and Hereford.	
Hudson.	
Boston (Havoc).	
Stirling.	
Maryland.	
Beaufort.	
Liberator.	
Fortress.	

5. The method of teaching aircraft is given as a specimen lesson below.

6. It is suggested that not more than two aircraft should be dealt with in any one lesson.

16. Specimen lesson

To teach any aircraft in detail the only kit necessary is the official silhouette of the aircraft concerned. A blackboard and chalk are of assistance. It is possible to teach each type in about 15 to 20 minutes. The important thing to remember is sequence ; by this means, nothing is missed, and the lesson is taught in the shortest possible time. The importance of questioning by the instructor cannot be over-emphasized ; he should question before starting, on previous types taught, and after, on the type he has taught.

The method and sequence of teaching is here shown applied to a Hurricane.

i. **Introduction**

Name (Hurricane).
Country of origin (British).
Design (Single seater fighter).

(*Brief statement of anything to arouse interest*), e.g. a very fast and heavily armed machine—one of the finest fighting planes in the world—has been used with great success at home and in France, Belgium, Holland, Greece, Egypt, and now in Russia. Together with the Spitfire it bore the brunt of the German attack during the " Battle of Britain ", shooting down hundreds of enemy planes.

ii. **Construction**

Type : Low-wing monoplane.
Engine(s) : Single, in-line, Rolls-Royce Merlin.
Horse-power : 1030 h.p.
Speed : Maximum 350 m.p.h. Cruising 275 m.p.h.
Range : About 3 hours.
Ceiling : 34,000 feet (service).
Armament : (Mark I) four M.Gs. in each wing. (Mark II) six M.Gs. or two (20 mm.) cannon in each wing.
Undercarriage retractable.
Camouflage : Fighter Command.

iii. *Head-on view.* (Start in centre and work outwards.)
Has a deep narrow fuselage with radiator underneath. Wings have short centre section and then very slight dihedral and taper to the tips. Tail plane medium high. Very little of fin can be seen.

iv. *Plan view.* (Start at nose and work back to tail.)
Pointed nose (due to " in-line " engine and spinner), wings have short straight centre section with equal taper on leading and trailing edges, to rounded tips. Fuselage narrow to tail plane which is same shape as main plane with small " cut-out."

v. *Side view.* (Start at nose, work along top of fuselage to fin and rudder, and then along bottom of fuselage.)
Pointed nose, low-wing, pilot's cockpit one-third way along fuselage with humped back. Sharp angle to rounded fin and rudder. Tail plane " sits " on top of fuselage. Straight

bottom to fuselage with radiator immediately under the cockpit.

vi. *Summary* : (Give, in the form of a telegram, the salient features of the machine, including its flying attitude).
Hurricane—British single-seater fighter—low-wing monoplane with single " in-line " engine. Pointed nose—taper on leading and trailing edges of wings—rounded tips. Very little dihedral. Deep narrow fuselage with humped back. Pilot's cockpit one-third way along with radiator below. Large rounded fin and rudder—tail plane above fuselage and same shape as main plane. Flying attitude—level, with humped back.

APPENDIX " A "—THEORY OF FLIGHT

Stores.—

Blackboard, coloured chalks, large model and charts.

Illustrate by simple diagrams.

The object of this lesson is to interest the soldier in aircraft and initiate him into becoming air-minded.

1. **Lift.** A moving object in stationary air acts in the same manner as a stationary object in moving air. Air offers resistance to a moving body and *vice versa.*

A force acting at right angles to the line of movement is produced when an inclined object moves against air resistance.

In the case of an aeroplane wing, different air pressures are produced on the upper and under side of the wing surfaces.

Lifting power depends on :—

i. Shape of wing (including size).

ii. Tilt of wing.

iii. Speed of movement.

Doubling speed of movement increases lift about four times.

2. **Angle of incidence** is the angle the wing section makes to the air resistance.

Tilt increases the lift until stalling angle (15 degrees) is reached—then lifting power falls.

Stalling is due to the air breaking away from above the upper rear portion of the wing, causing lack of lift and control.

3. **Drag** is air resistance to forward movement. Wing drag varies according to :—

i. Shape of wing (size).

ii. Angle of incidence.

iii. Speed of movement.

Increasing angle of incidence increases drag as well as lift.

Doubling speed of movement also increases drag as well as lift.

Object of aero design is to obtain the best compromise between lift and drag, dependent on what the plane is required for, i.e. for a fighter, low drag and high speed is more important than high lift (load), and for bombers or transport planes the reverse is the case.

Aerofoil and Streamline.

Lift to drag ratio :—

25 to 1 on level.

11 to 1 at 15 degrees.

$2\frac{1}{2}$ to 1 beyond 15 degrees.

Fuselage—engine and undercarriage also produce drag, and streamlining these is of great importance.

4. i. **Slots**—designed by Handley-Page and put on leading edge of wing, to smooth out air flow at high angles of incidence and in slow forward movement, and so to prevent stalling—operate automatically.

ii. **Flaps**—fitted on and in trailing edge of wing near fuselage, to increase drag and slow down the machine whilst maintaining lift by kite action ; various kinds—plain, hinged, and extending (Fowlers). Flaps on both wings operate together.

5. **Airscrew.** Has aerofoil section and acts in same manner as a wing. Lift is at right angles and is forward —it is technically known as " thrust." Lift or thrust varies according to angle of incidence of blades and speed of rotation.

i. Fixed pitch—explain principle of gears.

ii. Variable pitch—taking off—top speed—cruising.

iii. Full feathering airscrews—engine cuts out.

6. **Stability.**

i. Directionable by fin—its position.

ii. Longitudinal by tailplane—its position.

iii. Lateral—by dihedral or anhedral, or both.

iv. Stub wings or sponsons and stub fin.

7. **Controls.**

i. Rudder or rudders.

ii. Elevators (both move together).

iii. Ailerons (both move together).

iv. Trimming tabs.

8. **Ceiling.**

i. Service.

ii. Absolute.

APPENDIX " B "—CONSTRUCTION AND DESIGN

1. Essentials of an aeroplane :—

i. Must fly.

ii. Must carry load.

iii. Must take off and alight.

2. To fly :—

i. It must have wings : dependent on its job they will vary in :—

(*a*) Span, for lift.
(*b*) Chord, for lift.
(*c*) Aerofoil section (thickness).
(*d*) Taper } streamlining.
(*e*) Anhedral } manœuvrability.
(*f*) Dihedral } stability.
(*g*) Number (biplane for lift without wide span).
(*h*) Fillet (attachment for strength).

ii. **Airscrew**—tractor or pusher, or both, to cause it to go forward to give whole machine lift.

Number of blades—two, three, four.

iii. **Engine**—to power airscrew ; power without weight.

Numbers of—radial, in-line, tandem.

Position of—in or on fuselage or wings ; high, mid, low.

3. To carry load.—Size and shape depends on its job.

i. Fighter—speed—streamlined.

ii. Bomber—crew, gun turrets, radio, bombs, petrol.

4. To take off and alight.—

i. Undercarriage—floats, hulls.

(*a*) To keep airscrew clear of ground or water.
(*b*) To carry fuselage until airborne.
(*c*) To absorb shocks caused by uneven ground or rough water, on taking off or alighting.
(*d*) To keep angle of wings at high lift angle.
(*e*) To enable plane to go to its hangar or moorings.

ii. Fixed :—

(*a*) Drag.
(*b*) Trousers—fairings, spats.
(*c*) Bracings.

iii. Retractable—outward, inward, forward, backward, semi.

5. Waterborne planes. — Seaplanes — flying boats — amphibians.

APPENDIX "C"—FEATURES TO LOOK FOR IN RECOGNITION

Stores —

Diagrams, blackboard and chalk.

Instructor's Note

Do NOT at this stage refer to any types or mention any by names.

1. The first thing is to observe which of the following main classes a machine belongs to :—

i. Monoplane.

ii. Biplane.

iii. Flying boat.

iv. Seaplane.

Show picture or diagram of each.

2. The most obvious features of an aircraft are :—

i. **Wings**

(*a*) Shape from in front : Flat



: a wide U



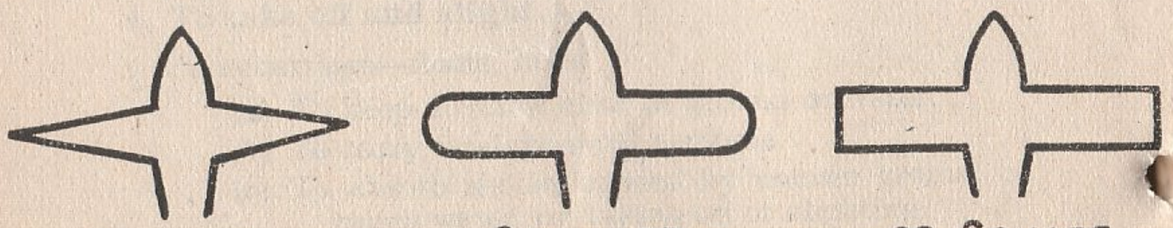
: a V



: a W



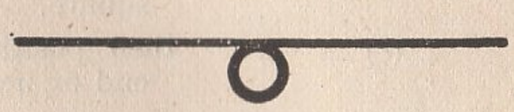
(*b*) Their shape from below may be—



or a combination of these.

(*c*) Their point of attachment to the fuselage which might be :—

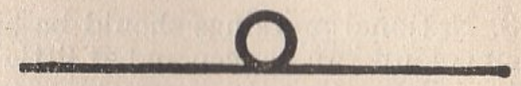
high wing.....



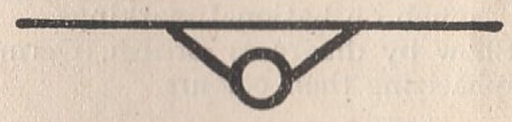
mid wing.....



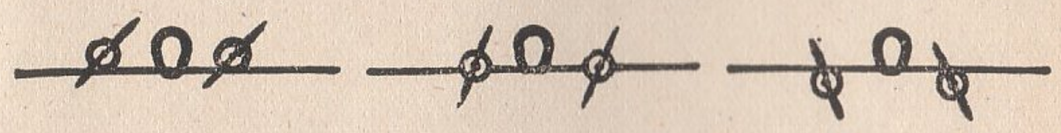
low wing.....



or parasol .....

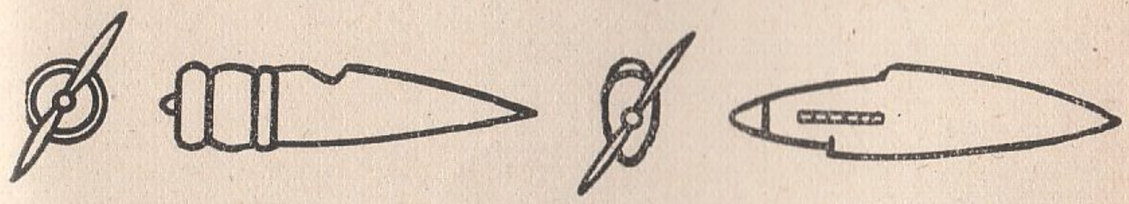


ii. **Engines.**—Number of engines one, two, three, or four, and their position on, in, or below the wings :—



and whether the engines are :—

radial (rounded) or in line (pointed)



iii. **Nose**

(*a*) Shape from side, e.g. round, square, pointed, or snout shaped, and again its shape from below.

(*b*) How far it sticks out compared with the engines, i.e. just as much, twice as far, just less, etc.

iv. Tail unit

(*a*) Shape of tail from below : same as wings.

(*b*) Its attachment—high, mid, or low.

(*c*) Rudders : their numbers—one, two, or three.

(*d*) ,, their shape—high, pointed, round, or square.

(*e*) ,, their position on tail plane—at the end or near the end.

v. Fuselage

Shape and length, e.g. long and tapering, short and fat, bottle-shaped, etc.

3. National markings should be known. At short distances their colours can be seen and at little longer ranges their shapes only. Remember the enemy may try and trick you ; do not rely much on national markings.

Show by diagrams British, German, and Italian markings, emphasizing their colours.

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